Report of the 8th Session of the IOTC Working Party on Neritic Tunas

Mahe, Seychelles, 21 – 24 August 2018

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ACRONYMS

B	Biomass (total)
BLT	Bullet tuna
B_{MSY}	Biomass which produces MSY
CMM	Conservation and Management Measure (of the IOTC; Resolutions and Recommendations)
C-MSY	Catch and Maximum Sustainable Yield data limited stock assessment method
COM	Narrow-barred Spanish mackerel
CPCs	Contracting parties and cooperating non-contracting parties
CPUE	Catch per unit of effort
current	Current period/time, i.e. $F_{current}$ means fishing mortality for the current assessment year.
EEZ	Exclusive Economic Zone
F	Fishing mortality; F_{2017} is the fishing mortality estimated in the year 2017
FAD	Fish aggregating device
F_{MSY}	Fishing mortality at MSY
FRI	Frigate tuna
GLM	Generalised Linear Model
GUT	Indo-Pacific king mackerel
IO	Indian Ocean
IOTC	Indian Ocean Tuna Commission
KAW	Kawakawa
LL	Longline
LOT	Longtail tuna
M	Natural mortality
MPF	Meeting Participation Fund
MSY	Maximum sustainable yield
n.a.	Not applicable
OCOM	Optimised Catch Only Method
PS	Purse-Seine
ROS	Regional Observer Scheme
SB	Spawning Biomass (sometimes expressed as SSB)
SB_{MSY}	Spawning stock Biomass which produces MSY
SC	Scientific Committee of the IOTC
SEAFDEC	Southeast Asian Fisheries Development Center
SRA	Stock Reduction Analysis
SWIOFP	South West Indian Ocean Fisheries Project
VB	Von Bertalanffy (growth)
WPDCS	Working Party on Data Collection and Statistics
WPNT	Working Party on Neritic Tunas of the IOTC
WWF	World Wide Fund for Nature (a.k.a World Wildlife Fund)

STANDARDISATION OF IOTC WORKING PARTY AND SCIENTIFIC COMMITTEE REPORT TERMINOLOGY

SC16.07 (para. 23) The SC **ADOPTED** the reporting terminology contained in Appendix IV and **RECOMMENDED** that the Commission considers adopting the standardised IOTC Report terminology, to further improve the clarity of information sharing from, and among its subsidiary bodies.

HOW TO INTERPRET TERMINOLOGY CONTAINED IN THIS REPORT

Level 1: ***From a subsidiary body of the Commission to the next level in the structure of the Commission:***
RECOMMENDED, RECOMMENDATION: Any conclusion or request for an action to be undertaken, from a subsidiary body of the Commission (Committee or Working Party), which is to be formally provided to the next level in the structure of the Commission for its consideration/endorsement (e.g. from a Working Party to the Scientific Committee; from a Committee to the Commission). The intention is that the higher body will consider the recommended action for endorsement under its own mandate, if the subsidiary body does not already have the required mandate. Ideally this should be task specific and contain a timeframe for completion.

Level 2: ***From a subsidiary body of the Commission to a CPC, the IOTC Secretariat, or other body (not the Commission) to carry out a specified task:***
REQUESTED: This term should only be used by a subsidiary body of the Commission if it does not wish to have the request formally adopted/endorsed by the next level in the structure of the Commission. For example, if a Committee wishes to seek additional input from a CPC on a particular topic, but does not wish to formalise the request beyond the mandate of the Committee, it may request that a set action be undertaken. Ideally this should be task specific and contain a timeframe for the completion.

Level 3: ***General terms to be used for consistency:***
AGREED: Any point of discussion from a meeting which the IOTC body considers to be an agreed course of action covered by its mandate, which has not already been dealt with under Level 1 or level 2 above; a general point of agreement among delegations/participants of a meeting which does not need to be considered/adopted by the next level in the Commission's structure.
NOTED/NOTING: Any point of discussion from a meeting which the IOTC body considers to be important enough to record in a meeting report for future reference.

Any other term: Any other term may be used in addition to the Level 3 terms to highlight to the reader of and IOTC report, the importance of the relevant paragraph. However, other terms used are considered for explanatory/informational purposes only and shall have no higher rating within the reporting terminology hierarchy than Level 3, described above (e.g. **CONSIDERED**; **URGED**; **ACKNOWLEDGED**).

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The 8th Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Neritic Tunas (WPNT08) was held in Mahé, Seychelles from 21 – 24 August 2018. A total of 18 participants (26 in 2017, 20 in 2016, 31 in 2015) attended the Session. The list of participants is provided at Appendix I. The meeting was opened by the Chairperson, Dr Farhad Kaymaram from I.R. Iran, who welcomed participants to the meeting including the Invited Expert, Dr Shijie Zhou, from CSIRO, Australia and the workshop facilitator Dr Rui Coelho, from IPMA, Portugal.

The following are a subset of the complete recommendations from the WPNT08 to the Scientific Committee which are provided at Appendix XIII.

(Para. 22) The WPNT **NOTED** that compliance with data reporting obligations is particularly low for neritic tuna species, despite the importance of scientific data for stock assessment, and **REQUESTED** CPCs do their best to collect data and comply with data reporting requirements adopted by the IOTC. The WPNT further **NOTED** that these issues have been noted for several years with little progress made intersessionally. While there are ongoing initiatives to tackle many of these issues, very little progress has been made and therefore the WPNT strongly **RECOMMENDED** that the Working Party on Data Collection and Statistics take up these issues and address them in that forum.

(Para. 75) The WPNT **NOTED** the low number of participants from CPCs at the current workshop (six excluding the Chair and Vice-Chair) partly due to the technical and specialised focus of the meeting, and **RECOMMENDED** that future capacity building actions and specialised workshops are conducted back-to-back with the regular Working Party meetings so that each CPC can send their most appropriate scientists to the WPs / Workshops.

(Para. 77) The WPNT **RECOMMENDED** that the Commission allocates funding for a consultancy to support the CPCs identified in Appendix VI with CPUE standardisation for the priority species identified.

(Para. 79) The WPNT **RECOMMENDED** that the SC consider and endorse the WPNT Program of Work (2019–2023), as provided in Appendix VI.

(Para. 82) The WPNT **NOTED** that Sri Lanka expressed interest in potentially hosting the 9th Session of the WPNT and **RECOMMENDED** the SC consider as preferred dates of either the last week of June or the first week of July 2019. The WPNT further **NOTED** that Kenya have expressed interest in potentially hosting the 10th Session of the WPNT in 2020 with dates yet to be agreed.

Meeting participation fund (MPF)

(Para. 83) The WPNT participants were unanimous in their thanks for the support for their participation in the meeting due to the MPF and **RECOMMENDED** that the Scientific Committee also consider the WPNT09 as a high priority meeting for MPF.

(Para. 84) The WPNT **RECOMMENDED** that the SC and Commission note the following:

1) The participation of developing coastal state scientists to the WPNT has been consistently high following the adoption and implementation of the IOTC Meeting Participation Fund adopted by the Commission in 2010 (Resolution 10/05 *On the establishment of a Meeting Participation Fund for developing IOTC Members and Non-Contracting Cooperating Parties*), now incorporated into the IOTC Rules of Procedure (2014), as well as though the hosting of the WPNT in developing coastal State Contracting Parties (Members) of the Commission (Table 8).
2) The continued success of the WPNT, at least in the short term, appears heavily reliant on the provision of support via the MPF which was established primarily for the purposes of supporting scientists to attend and contribute to the work of the Scientific Committee and its Working Parties.
3) The MPF should be utilised so as to ensure that all developing Contracting Parties of the Commission are able to attend the WPNT meeting, as neritic tunas are very important resources for many of the coastal countries of the Indian Ocean.

(Para. 85) The WPNT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPNT08, provided at Appendix XIII, as well as the management advice provided in the draft resource stock status summary for each of the six neritic tuna (and mackerel) species

under the IOTC mandate, and the combined Kobe plot for the species assigned a stock status in 2018 (Fig. 1):

- Bullet tuna (*Auxis rochei*) – Appendix VII
- Frigate tuna (*Auxis thazard*) – Appendix VIII
- Kawakawa (*Euthynnus affinis*) – Appendix IX
- Longtail tuna (*Thunnus tonggol*) – Appendix X
- Indo-Pacific king mackerel (*Scomberomorus guttatus*) – Appendix XI
- Narrow-barred Spanish mackerel (*Scomberomorus commerson*) – Appendix XII

Table 1. Status summary for species of neritic tuna and tuna-like species under the IOTC mandate: 2018

Neritic tunas and mackerel: These six species have become as important or more important as the three tropical tuna species (bigeye tuna, skipjack tuna and yellowfin tuna) to most IOTC coastal states with a total estimated catch of 627 851 t landed in 2017. They are caught primarily by coastal fisheries, including small-scale industrial and artisanal fisheries. They are almost always caught within the EEZs of coastal states. Historically, catches were often reported as aggregates of various species, making it difficult to obtain appropriate data for stock assessment analyses.

Stock	Indicators	Previous	13	14	15	16	17	18	Advice to the Commission
Bullet tuna *Auxis rochei*	Catch 2017: 11,094 t Average catch 2013–2017: 9,959 t MSY (1,000 t) unknown F_{MSY}: unknown B_{MSY} (1,000 t): unknown $F_{current}/F_{MSY}$: unknown $B_{current}/B_{MSY}$: unknown $B_{current}/B_0$: unknown								For assessed species of neritic tunas in Indian Ocean (longtail tuna, kawakawa and narrow barred Spanish mackerel), the MSY was estimated to have been reached between 2009 and 2011 and both F_{MSY} and B_{MSY} were breached thereafter. Therefore, in the absence of a stock assessment of bullet tuna a limit to the catches should be considered by the Commission, by ensuring that future catches do not exceed the average catches estimated between 2009 and 2011 (8,870 t). The reference period (2009-2011) was chosen based on the most recent assessments of those neritic species in the Indian Ocean for which an assessment is available under the assumption that also for bullet tuna MSY was reached between 2009 and 2011. This catch advice should be maintained until an assessment of bullet tuna is available. Considering that MSY-based reference points for assessed species can change over time, the stock should be closely monitored. Mechanisms need to be developed by the Commission to improve current statistics by encouraging CPCs to comply with their recording and reporting requirements, so as to better inform scientific advice. Click here for a full stock status summary: Appendix VII
Frigate tuna *Auxis thazard*	Catch 2017: 74,686 t Average catch 2013–2017: 86,117 t MSY (1,000 t) unknown F_{MSY}: unknown B_{MSY} (1,000 t): unknown $F_{current}/F_{MSY}$: unknown $B_{current}/B_{MSY}$: unknown $B_{current}/B_0$: unknown								For assessed species of neritic tunas in Indian Ocean (longtail tuna, kawakawa and narrow barred Spanish mackerel), the MSY was estimated to have been reached between 2009 and 2011 and both F_{MSY} and B_{MSY} were breached thereafter. Therefore, in the absence of a stock assessment of frigate tuna a limit to the catches should be considered by the Commission, by ensuring that future catches do not exceed the average catches estimated between 2009 and 2011 (94,921 t). The reference period (2009-2011) was chosen based on the most recent assessments of those neritic species in the Indian Ocean for which an assessment is available under the assumption that also for bullet tuna MSY was reached between 2009 and 2011. This catch advice should be maintained until an assessment of frigate tuna is available. Considering that MSY-based reference points for assessed species can change over time, the stock should be closely monitored. Mechanisms need to be developed by the Commission to improve current statistics by encouraging CPCs to comply with their recording and reporting requirements, so as to better inform scientific advice. Click here for a full stock status summary: Appendix VIII
Kawakawa *Euthynnus affinis*	Catch 2017[2]: 159,752 t Average catch 2013-2017 157,300 t MSY (1,000 t) [*] 152 [125 –188] F_{MSY} [*] 0.56 [0.42–0.69] B_{MSY} (1,000 t) [*] 202 [151–315] F_{2013}/F_{MSY} [*] 0.98 [0.85–1.11] B_{2013}/B_{MSY} [*] 1.15 [0.97–1.38] B_{2013}/B_0 [*] 0.58 [0.33–0.86]								Although the stock status is classified as not overfished and not subject to overfishing, the Kobe strategy II matrix developed in 2015 showed that there is a 96% probability that biomass is below MSY levels and 100% probability that $F>F_{MSY}$ by 2016 and 2023 if catches are maintained at the 2013 levels. There is a 55% probability that biomass is below MSY levels and 91% probability that $F>F_{MSY}$ by 2023 if catches are maintained at around 2016 levels. The modelled probabilities of the stock achieving levels consistent with the MSY reference points (e.g. SB > SB_{MSY} and $F<F_{MSY}$) in 2023 are 100% for a future constant catch at 80% of 2013 catch levels. If catches are reduced by 20% based on 2013 levels at the time of the assessment

Stock	Indicators	Previous	13	14	15	16	17	18	Advice to the Commission
									(170,181 t)[1], the stock is expected to recover to levels above MSY reference points with a 50% probability by 2023. Click here for a full stock status summary: Appendix IX
Longtail tuna *Thunnus tonggol*	Catch 2017[2]: 135,006 t Average catch 2013–2017: 139,856 t MSY (1,000 t) (*): 140 (103–184) F_{MSY} (*): 0.43 (0.28–0.69) B_{MSY} (1,000 t) (*): 319 (200–623) F_{2015}/F_{MSY} (*): 1.04 (0.84–1.46) B_{2015}/B_{MSY} (*): 0.94 (0.68–1.16) B_{2015}/B_0 (*): 0.48 (0.34–0.59)								There is a substantial risk of exceeding MSY-based reference points by 2018 if catches are maintained at current (2015) levels (63% risk that $B_{2018}<B_{MSY}$, and 55% risk that $F_{2018}>F_{MSY}$) (Table 2). If catches are reduced by 10% this risk is lowered to 33% probability $B_{2018}<B_{MSY}$ and 28% probability $F_{2018}>F_{MSY}$). If catches are capped at current (2015) levels at the time of the assessment (i.e. 136,849 t), the stock is expected to recover to levels above MSY reference points with at least a 50% probability by 2025. Catches have remained below estimated MSY since 2015. Click here for a full stock status summary: Appendix X
Indo-Pacific king mackerel *Scomberomorus guttatus*	Catch 2017[2]: 49,905 t Average catch 2013-2017: 46,814 t MSY (1,000 t) Unknown F_{MSY} : Unknown B_{MSY} (1,000 t): Unknown $F_{current}/F_{MSY}$: Unknown $B_{current}/B_{MSY}$: Unknown $B_{current}/B_0$: Unknown								For assessed species of neritic tunas in Indian Ocean (longtail tuna, kawakawa and narrow barred Spanish mackerel), the MSY was estimated to have been reached between 2009 and 2011 and both F_{MSY} and B_{MSY} were breached thereafter. Therefore, in the absence of a stock assessment of Indo-Pacific king mackerel a limit to the catches should be considered by the Commission, by ensuring that future catches do not exceed the average catches estimated between 2009 and 2011 (46,787 t). The reference period (2009-2011) was chosen based on the most recent assessments of those neritic species in the Indian Ocean for which an assessment is available under the assumption that also for Indo-Pacific king mackerel MSY was reached between 2009 and 2011. This catch advice should be maintained until an assessment of Indo-Pacific king mackerel is available. This catch advice should be maintained until an assessment of Indo-Pacific king mackerel is available. Considering that MSY-based reference points for assessed species can change over time, the stock should be closely monitored. Mechanisms need to be developed by the Commission to improve current statistics by encouraging CPCs to comply with their recording and reporting requirements, so as to better inform scientific advice. Click here for a full stock status summary: Appendix XI
Narrow-barred Spanish mackerel *Scomberomorus commerson*	Catch 2017[2]: 159,370 t Average catch 2013-2017: 160,812 t MSY (1,000 t) [*]: 131 [96–180] F_{MSY} [*]: 0.35 [0.18–0.7] B_{MSY} (1,000 t) [*]: 371 [187–882] F_{2015}/F_{MSY} [*]: 1.28 [1.03–1.69] B_{2015} B_{MSY} [*]: 0.89 [0.63–1.15] B_{2015}/B_0 [*]: 0.44 [0.31–0.57]								There is a continued high risk of exceeding MSY-based reference points by 2025, even if catches are reduced to 80% of the 2015 levels (73% risk that $B_{2025}<B_{MSY}$, and 99% risk that $F_{2025}>F_{MSY}$). The modelled probabilities of the stock achieving levels consistent with the MSY reference levels (e.g. $B > B_{MSY}$ and $F<F_{MSY}$) in 2025 are 93% and 70%, respectively, for a future constant catch at 70% of current catch level. If catches are reduced by 30% of the 2015 levels at the time of the assessment, which corresponds to catches below MSY, the stock is expected to recover to levels above the MSY reference points with at least a 50% probability by 2025 (Table 2).. Click here for a full stock status summary: Appendix XII

*Indicates range of plausible values

Colour key	Stock overfished($SB_{year}/SB_{MSY}< 1$)	Stock not overfished ($SB_{year}/SB_{MSY}\geq 1$)
Stock subject to overfishing($F_{year}/F_{MSY}> 1$)		
Stock not subject to overfishing ($F_{year}/F_{MSY}\leq 1$)		
Not assessed/Uncertain		

[1] as estimated in 2015

1. Opening of the Meeting

1. The 8th Session of the Indian Ocean Tuna Commission's (IOTC) Working Party on Neritic Tunas (WPNT08) was held in Mahé, Seychelles from 21 – 24 August 2018. A total of 18 participants (26 in 2017, 20 in 2016, 31 in 2015) attended the Session. The list of participants is provided at Appendix I. The meeting was opened by the Chairperson, Dr Farhad Kaymaram from I.R. Iran, who welcomed participants to the meeting including the Invited Expert, Dr Shijie Zhou, from CSIRO, Australia and the workshop facilitator Dr Rui Coelho, from IPMA, Portugal.

2. Adoption of the Agenda and Arrangements for the Session

2. The WPNT **ADOPTED** the Agenda provided at Appendix II. The documents presented to the WPNT08 are listed in Appendix III.

3. The IOTC process: Outcomes, updates and progress

3.1 Outcomes of the 20th Session of the Scientific Committee

3. The WPNT **NOTED** paper IOTC–2018–WPNT08–03 which outlined the main outcomes of the 20th Session of the Scientific Committee (SC20), specifically related to the work of the WPNT and **AGREED** to consider how best to progress these issues at the present meeting.

4. The WPNT **NOTED** the changes made by the SC to the assessment schedule to a 3-year assessment cycle with a focus on a single issue in other years with biological parameters set as the priority for 2019.

3.2 Outcomes of the 22nd Session of the Commission

5. The WPNT **NOTED** paper IOTC–2018–WPNT08–04 which outlined the main outcomes of the 22nd Session of the Commission, specifically related to the work of the WPNT.

6. The WPNT **NOTED** the 10 Conservation and Management Measures (CMMs) adopted at the 22nd Session of the Commission (consisting of 10 Resolutions and 0 Recommendations) which will come into force on 4th October 2018:
   - Resolution 18/01 *On an interim plan for rebuilding the Indian ocean yellowfin tuna stock in the IOTC area of competence.*
   - Resolution 18/02 *On management measures for the conservation of blue shark caught in association with IOTC fisheries.*
   - Resolution 18/03 *On Establishing a List of Vessels Presumed to Have Carried Out Illegal, Unreported and Unregulated Fishing in the IOTC Area of Competence.*
   - Resolution 18/04 *On bioFAD experimental project.*
   - Resolution 18/05 *On management measures for the conservation for the conservation of billfish, striped marlin, black marlin, blue marlin and Indo-Pacific sailfish.*
   - Resolution 18/06 *On establishing a programme for transhipment by large-scale fishing vessels.*
   - Resolution 18/07 *On measures applicable in case of non-fulfilment of reporting obligations in the IOTC.*
   - Resolution 18/08 *Procedures on a Fish Aggregating Devices (FADs) Management Plan, Including a Limitation on the Number of FADs, More Detailed Specifications of Catch Reporting from FAD sets, and the Development of Improved FAD Design to Reduce the Incidence of Entanglement of Non-Target Species.*
   - Resolution 18/09 *On a scoping study of socio-economic indicators of IOTC fisheries.*
   - Resolution 18/10 *On vessel chartering in the IOTC Area of Competence.*

7. Participants to WPNT08 were **ENCOURAGED** to familiarise themselves with the adopted Resolutions, especially those most relevant to the WPNT.

3.3 Review of Conservation and Management Measures relevant for neritic tunas

8. The WPNT **NOTED** paper IOTC–2018–WPNT08–05 which aimed to encourage participants at the WPNT08 to review some of the existing Conservation and Management Measures (CMM) relating to neritic tunas, noting that these have now been revised as described in document IOTC–2018–WPNT08–04.

3.4 Progress on the Recommendations of WPNT07 and SC20

9. The WPNT **NOTED** paper IOTC–2018–WPNT08–06 which provided an update on the progress made in implementing the recommendations from the 7th Session of the WPNT for the consideration and potential endorsement by participants.

10. The WPNT participants were **ENCOURAGED** to review IOTC-2018-WPNT08-06 during the meeting and report back on any progress in relation to requests or actions by CPCs that have not been captured by the report, and to note any pending actions for attention before the next meeting (WPNT09).

11. The WPNT **REQUESTED** that the IOTC Secretariat continue to annually prepare a paper on the progress of the recommendations arising from the previous WPNT, incorporating the final recommendations adopted by the Scientific Committee and endorsed by the Commission.

4. New Information on Fisheries and Associated Environmental Data Relating to Neritic Tunas

4.1 Review of the statistical data available for neritic tunas: IOTC database

12. The WPNT **NOTED** paper IOTC–2018–WPNT08–07 which provided an overview of the standing of a range of information received by the IOTC Secretariat for the six species of neritic tuna and tuna-like species, in accordance with IOTC Resolution 15/02 *Mandatory statistical reporting requirements for IOTC Members and Cooperating non-Contracting Parties (CPCs)*, for the period 1950–2017. A summary is provided at Appendix IVa–IVf.

13. The WPNT **NOTED** that the IOTC Secretariat, in collaboration with Indonesian national fisheries scientists, is in the process of re-estimating the catches for Indonesia's fresh longline fishery, but the changes are unlikely to significantly impact the overall catches of neritic species estimated for Indonesia.

14. The WPNT **NOTED** that revisions to Pakistan's historical catches, submitted to IOTC by the Government of Pakistan in 2017, will only be uploaded into the IOTC database when the estimation methodology is clarified, as the sharp increase in catches reported since 2015 may affect future stock assessment results for neritic and tropical tunas. The WPNT **REQUESTED** that the IOTC Secretariat liaise with the Government of Pakistan to appraise the revised catch series and resolve current inconsistencies between the officially reported catches and IOTC best scientific catch estimates for Pakistan as a matter of priority.

15. The WPNT **NOTED** that while the catch trends of neritic tunas may have reached a peak, indicating the possibility that species might be overfished, this may also be due in part to the non-reporting of catches from several of the major fishing nations, whose catches in the IOTC database have been repeated from previous years in the absence of any other information.

16. It was further **NOTED** that as catches are still the most complete dataset available, catch-only assessments may still be the best methods to use.

17. The WPNT **NOTED** that data-related issues are a combination of both a lack of availability of data as well as issues with data reporting and that both of these challenges need to be addressed. The WPNT **REQUESTED** that CPC scientists presenting information at Working Party meetings ensure that this data has been submitted to the IOTC Secretariat prior to the meeting.

18. **NOTING** that despite access to the Meeting Participation Fund (MPF), the attendance of CPC scientists from developing coastal states at the 8th session of the WPNT was particularly low, and also the absence of representatives from some of the main CPCs important for catches of neritic tunas, such as India, Malaysia, I.R. Iran and Pakistan. The WPNT **REQUESTED** the IOTC Executive Secretary liaise with these nations at a high level and engage Managers and Head Delegates to the Commission directly to encourage the participation of their national scientists in the Working Party meetings and facilitate improvements in the submission of the mandatory IOTC datasets.

19. The WPNT strongly **ENCOURAGED** I.R. Iran and Comoros to work with the IOTC Secretariat and FAO to resolve the issue regarding the arrears in payment of their IOTC contribution. This will facilitate access to the MPF for scientists from I.R.Iran and Comoros and enable their participation in future WPNT meetings.

20. The WPNT **CONGRATULATED** I.R. Iran for improvements in the recent submission of time-area catches, following a successful Data Compliance and Support mission by the IOTC Secretariat in late-2017. In terms of neritic species, the submitted catch-and-effort data covers around 10% of total catches by species (for 2015-2017) which is an important improvement considering the limited availability of data for such species.

21. The WPNT **RECALLED** a number of reasons for the low levels of compliance in terms of data reporting of neritic species, including:

    i. Technical or financial constraints in implementing data collection, processing and reporting systems for fisheries datasets, particularly in the context of small-scale coastal fisheries, which account for the majority of catches of neritic species (e.g., Pakistan).

    ii. Limitations on current data collection mechanisms to fully report catches by species or gear according to the IOTC data requirements, or difficulties sampling IOTC species in sufficient numbers (e.g., Kenya, prior to implementation of the recent Catch Assessment Survey; also Thailand and Malaysia coastal fisheries, which catch relatively low quantities of neritic species; I.R. Iran catch-and-effort according to the IOTC data reporting requirements).

    iii. Difficulties understanding IOTC data reporting obligations, or issues processing data in the format required by IOTC (e.g., Thailand size frequency data in recent years).

    iv. Limited coordination between national institutions responsible for collecting IOTC datasets which often combine data collection activities across more than one fisheries agency, such as the Ministry of Fisheries and fisheries research organisations (e.g., India and Tanzania).

22. The WPNT **NOTED** that compliance with data reporting obligations is particularly low for neritic tuna species, despite the importance of scientific data for stock assessment, and **REQUESTED** CPCs do their best to collect data and comply with data reporting requirements adopted by the IOTC. The WPNT further **NOTED** that these issues have been noted for several years with little progress made intersessionally. While there are ongoing initiatives to tackle many of these issues, very little progress has been made and therefore the WPNT strongly **RECOMMENDED** that the Working Party on Data Collection and Statistics take up these issues and address them in that forum.

23. The WPNT **REQUESTED** that data on neritic tunas, including catch, effort, and size frequency data, are submitted to the IOTC Secretariat as per the requirements adopted by IOTC Members in Resolution 15/02. This would allow the WPNT to develop additional or more refined stock status indicators for use in undertaking stock assessments on the neritic tuna species under the IOTC mandate.

24. The WPNT **NOTED** the main data issues that are considered to negatively affect the quality of the statistics for neritic tunas available at the IOTC Secretariat, by type of dataset and fishery, which are provided in Appendix V, and **ENCOURAGED** the CPCs listed in Appendix V to make efforts to remedy the data issues identified and to report back to the WPNT at its next meeting.

25. The WPNT further **NOTED** the distribution of catches of neritic species are not equal across CPCs but that the largest fisheries are concentrated in Indonesia, I.R. Iran, India, and Pakistan (which together account for over 75% of the total catches of neritic species in recent years), and **REQUESTED** that support for data reporting from these countries is prioritised by the IOTC Secretariat to improve the reporting of mandatory datasets.

26. The WPNT also strongly **ENCOURAGED** participants to be more directly involved in the collection, and compilation of data submitted to the IOTC Secretariat, and to attend the Working Party on Data Collection and Statistics to share expertise in data collection systems for coastal fisheries and to facilitate improvements in data reporting compliance.

27. The WPNT **ACKNOWLEDGED** that for many CPCs port sampling is still the main method of data collection for the inshore fisheries catching neritic tunas and may, at present, be the best source of data for CPUE standardisation until logbooks and observer schemes become more established. Given the lack of guidance on how port sampling information should be collected, the WPNT **REQUESTED** that participants bring their port sampling data collection templates to the next Working Party meeting for the group to review and provide advice on, and further **REQUESTED** the IOTC Secretariat source some example templates from fisheries with more developed port sampling data collection systems for comparison.

28. The WPNT **NOTED** the FAO presentation on assessment and management approaches for stocks with different levels of data availability. The presentation provided an introduction to data management, and then discussed the different levels/types of assessment that can be conducted depending on the quality of data available. It was noted that assessed stocks have a better chance to be sustainably managed; however, data and technical complexities may preclude use of model-based approaches in which case empirical indicators and decision rules should be used to inform management. It was noted that when information is scarce or of bad quality, management should be increasingly precautionary. Ultimately, it was concluded that data limitations should not preclude management.

29. The WPNT **THANKED** the FAO representative for providing the presentation and **ACKNOWLEDGED** this initiative was of particular interest to the WPNT, as neritic tuna species are generally considered to be data poor.

30. The WPNT **AGREED** that data poor approaches should be further considered, including data poor MSE techniques. These methods provide a powerful tools to assess neritic tuna species incorporating additional information and uncertainty which is more appropriate than only using past total catch data.

31. The WPNT **OBSERVED** that it is critical to fully understand the data being analysed. It was **NOTED** that a particular analytical method should not be applied simply because it is available, but should be appropriate to and consistent with the characteristics of the data to be analysed.

32. The WPNT **ENCOURAGED** the FAO to continue development of a Catalogue providing guidance on which data assessment approaches are appropriate for each type of dataset. It was **NOTED** that there is available literature which discusses the various data poor methods and theory in detail, however, the current initiative is intending to finalise a manual providing guidance on how to use the various methods in a more user-friendly format.

5. CPUE: SETTING THE SCENE

5.1 General introduction to CPUE

33. The WPNT **NOTED** the introductory presentation on the principles of catch per unit of effort, explaining why raw CPUE is not usually useful as an index of abundance and the rationale for standardisation to ensure the final index reflects abundance rather than changes in catchability.

5.2 Summary of IOTC work on CPUE undertaken to-date

34. The WPNT **NOTED** that the CPUE index for Kawakawa from the Maldives pole and line fishery drives the assessment even though the Maldives fishery accounts for only ~10% of the total Indian Ocean catches of Kawakawa, so it is questionable whether this is appropriate. Nevertheless, although only a small proportion of the stock may be accounted for, if there is reason to believe that the index is still representative of the entire stock then this may not be problematic.

35. The WPNT **NOTED** the range of issues encountered in standardising catch rates for the industrial fisheries of IOTC and **ACKNOWELDGED** that there may be somewhat different issues encountered when analysing artisanal fisheries.

6. INTRODUCTION TO R

6.1 Getting data into R

36. The WPNT **NOTED** the tutorial provided by the facilitator regarding the basics of importing data into the R programming environment. The tutorial incorporated a step by step guide for the participants on how to import their own data into R, using simple code as provided. The tutorial also introduced the participants to R studio, which is a free and open-source integrated development environment for R.

37. The WPNT **ACKNOWLEDGED** the utility of using free and open sourced software which does not imply an additional financial burden to users and is constantly being updated and upgraded. The relatively user-friendly interface provided by R studio was also welcomed. The WPNT further **ACKNOWLEDGED** that carrying out analysis and sharing R scripts allows for collaborative work between scientists as well as producing analysis in a transparent and reproducible way.

6.2 Data exploration

38. The WPNT **NOTED** the further tutorial provided by the facilitator on manipulating and visualising the data imported into R. Several basic data exploratory tools were demonstrated as well as visualisation packages for plotting and analysing the data.

39. The WPNT **THANKED** the facilitator for providing this very useful tutorial as well as all the associated code for the participants to apply to their own data.

7. STATISTICAL MODELS

7.1 Introduction to linear and generalised linear models

40. The WPNT **NOTED** the tutorial provided by the IOTC Secretariat on the introduction to Linear and General Linear Modelling. The WPNT **THANKED** the IOTC Secretariat for clearly explaining the relatively complex theory behind these different models as well as the technical applications for them.

41. The WPNT further **NOTED** the utility of these methods and how they could be applied to analysing the catch and effort data collected by the CPCs. This tutorial provided a crucial step towards addressing the actual standardisation of CPUE series.

8. CPUE STANDARDISATION

8.1 Examples of CPUE standardisation (NOAA LL-SIM datasets)

42. The WPNT **NOTED** the presentation by the invited expert describing a new spatiotemporal method of CPUE standardisation.

43. The WPNT **THANKED** the invited expert for the presentation and **AGREED** that this approach appears to perform well in explaining more of the deviance as it enables the incorporation of continuous spatial and temporal variables. However, the WPNT also **ACKNOWLEDGED** that this is a complex method compared with the classical approaches and may be something to consider in future years when more data and expertise are available.

44. The WPNT **NOTED** the predictive ability of the models which extends to areas for which there are data gaps as well as to areas just outside the boundary of the mesh for which there are no catch data, however, it was **ACKNOWLEDGED** that the predictive power of the model in these areas was dependent on whether sufficient environmental variables are included in the analysis.

9. CPC DATASETS

9.1 Review of new CPUE information on neritic tuna fisheries

Kenya neritic tuna fisheries

45. The WPNT **NOTED** paper IOTC–2018–WPNT08–10 which assessed the impact of artisanal fishing gears on narrow-barred Spanish mackerel (*Scomberomorus commerson*) in the Kenyan marine ecosystem, including the following abstract provided by the authors:

"A study was conducted to provide an overview on the various fishing gears used by artisanal fishermen to determine the most effective gear used to catch King Fish (Scomberomorus commerson).The main objective of this study is to identify the opportunities for improvement of the existing fisheries management strategies, focusing on fish biodiversity and conservation. The study focused on artisanal Fishermen that use hand lines, gill nets, monofilaments, trolling lines, ring net and long lines fishing gears. Data collection was undertaken through Catch Assessment Survey (CAS) and Fishing Effort Survey (FES). An analysis of the data collected was done which showed the sum sample landings for trolling lines was 19108 kgs, hand lines 16996 kgs, gill net 14158 kgs and ring net 2842 kgs. Gear versus average weight of fish caught in kgs showed trolling line 11.3 kg, long line 11 kg, hand line 7 kg and gill net 5 kg. Monthly counts for samples taken recorded September as the peak with 334 counts, December 285 counts, July 264 counts and October 233 counts. Gear type versus number of fish caught per gear; Hand line 978 pieces, trolling line 586 pieces and gill net 466 pieces. In conclusion trolling line was the most effective gear used to catch king fish, followed by hand lines on average weight landed. Trolling lines caught the biggest sizes of king fish, while hand lines caught more numbers of king fish than trolling lines. This study shows clearly artisanal gears that are active in catching king fish in terms of weight per each piece of fish and size are trolling lines and hand lines as well as gears that have insignificant impact on the king fish population .i.e. Monofilaments, long lines, reef seines etc.".

46. The WPNT **ACKNOWLEDGED** the efforts Kenya has made to provide a time series of catch and effort data for artisanal fisheries (2013-2017) and **ECOURAGED** the Kenyan scientists to investigate the possibility of conducting a CPUE standardisation analysis on this information.

47. The WPNT **ENCOURAGED** Kenya to report information on length frequencies as well as catch and effort data, particularly for narrow-barred Spanish mackerel, which is collected by the Catch Assessment Survey. This is particularly relevant given the lack of data for neritic species in the IOTC database from the western Indian Ocean, despite the fact that this data appears to exist.

48. The WPNT **REQUESTED** clarification as to the proportion of total catch represented by the sampling scheme outlined in the paper. Although it appears that many vessels were sampled, it was acknowledged that this represents a fairly low proportion of the entire catch. This should be taken into consideration when scaling this information up to represent the entire catch series. The WPNT further **REQUESTED** that this be taken into account when designing future sampling schemes for these species.

Sri Lanka neritic tuna fisheries

49. The WPNT **NOTED** paper IOTC–2018–WPNT08–11 analysing the relationship between frigate tuna (*Auxis thazard*) Catch Per Unit Effort (CPUE) and fishing operation related parameters, including the following abstract provided by the authors:

"Frigate tuna (Auxis thazard) is a key species in neritic tuna production in Sri Lankan. Landings of frigate tuna mostly come as a by-catch by fishing operations in tuna fishery mainly from four single gears (gillnet, pole & line, ringnet and trolling line) and three gear combinations (gillnet-handline, gillnet-ringnet, gillnet-longline). As a highly diverse fishing operations in frigate tuna landings, catch rates could vary with respect to different fishing operational parameters. The aim of the study was to find out the relationship between catch rates of frigate tuna and fishing operation related parameters in the tuna fishery of Sri Lanka. Frigate tuna catch landings and fishing operation related parameters were extracted for the period of 2005 to 2017 from the large pelagic fishery database (PELAGOS) of National Aquatic Resources Research & Development Agency (NARA). A Gamma based Generalized Linear Model (GLM) was fitted to describe the relationship between frigate tuna monthly average CPUE and fishing operation related parameters. The fitted GLM model explains 71.5% of the total deviance and the vessel type was found to be the most significant factor for determining the catch rates of frigate tuna. Among the first order interactions, year:month was the key explanatory variable followed by the year:gear type.".

50. The WPNT **CONGRATULATED** the authors for this study describing the first attempt at standardising CPUE for neritic tunas from the Sri Lankan fisheries and, acknowledging that that this may be one of the most comprehensive datasets for neritic tunas in the Indian Ocean, **ENCOURAGED** the further development of this study. However, the WPNT **NOTED** that the sampling rate for the fishery is unknown, so it is not clear how representative the dataset is of the entire Sri Lankan fleet. Sri Lanka confirmed that the sampling rate will be provided in time for the WPNT09.

51. The WPNT **NOTED** that the lack of spatial information incorporated in the standardisation model and that Sri Lankan vessels do not consistently operate in the same region. It was clarified that the fleet moves between the North East and South West depending on the season of the year. It was **NOTED** that this will have an effect on the standardisation of the CPUE series and must be taken into account in future work.

52. The WPNT **NOTED** that zero catch records were excluded from the data analysis. It was clarified that the proportion of zero catches in the dataset varied between gear types. The WPNT **ENCOURAGED** the Sri Lankan scientists to investigate whether the zero catches are informative. For example, longline vessels targeting larger tuna have a high proportion of zero catch records, however, this is due to the fact that neritic tunas are not being selected by this gear type and so are probably not appropriate to be included in the analysis.

53. The WPNT also **NOTED** that the model combines various gear types in the analysis. As the catchability between gear types is very different, this will negatively affect the usefulness of this estimated abundance index. It was therefore suggested that separate analyses should be attempted for each gear type. The WPNT **ACKNOWLEDGED** that this may be complicated as vessels often combine fishing gears during a trip and therefore it may not be possible to separate the information by gear.

54. The WPNT **NOTED** that the standardisation model estimated a large number of parameters, including several interaction terms which included a year interaction. It was **SUGGESTED** that instead of including year interactions as a factor, it could be included as a random effect to reduce the number of parameters in the model. This would also reduce the need to extract the year effect from the multiple interaction terms.

Comoros neritic tuna fisheries

55. The WPNT **NOTED** paper IOTC–2018–WPNT08–12 analysing the catch and effort of neritic tuna in Comoros from 2011 to 2015, including the following abstract provided by the authors:

"Neritic tuna from Comorian fisheries represents a weak part of the annual total catch but really helps the local consumption in term of product variability and market. Its production represents 2.69% of annual total production of these five last years. Neritic tuna is the fourth important component of fishery behind tropical tuna, small pelagic and tuna like component. The main specie caught is Kawakawa (Euthynnus affinis), followed by Bullet tuna (Auxis rochei). The Frigate tuna (Auxis thazard) and the Longtail tuna (Thunnus tonggol) are not often caught. The Indo-Pacific king mackerel (Scomberomorus guttatus) and Narrow-barred Spanish mackerel (Scomberomorus commerson) are extremely rare. All this neritic tuna are mainly caught by trolling line or hook and line using fibber glass small boat or wooden pirogue. The main fishing gear is depending on the habit of the Comorian Island you are".

56. The WPNT **THANKED** the authors for providing the document but expressed regret that they were not present to explain and discuss their findings.

Indonesia neritic tuna fisheries

57. The WPNT **NOTED** paper IOTC–2018–WPNT08–13 analysing the catch per unit effort (CPUE) and size distribution of kawakawa (E*uthynnus affinis*) from Indonesia fisheries management area (FMA) 573, including the following abstract provided by the authors:

"Tunas are very important fish species for marine fisheries in Indonesia. Besides large tunas, another important catch for fishermen in Indonesia is neritic tuna include kawakawa (Euthynnus affinis). In Indonesia, Kawakawa is grouped as "tongkol" together with Thunnus tonggol, Auxis rochei, and Auxis thazard. The objectives of this study were to investigate the catch per unit effort (CPUE) and size distribution of kawakawa caught from Indonesia Fisheries Management Area (FMA) 573. Data were collected from two fishing ports (Prigi and Labuhan Lombok) using enumeration method. The gear which was used to catch kawakawa in Prigi were troll line and drift gillnet in Labuhan Lombok. The CPUE was varied monthly in both ports. It was 16,4 – 92,6 kg/day from Labuhan Lombok and 12,4 – 50,6 from Prigi. The kawakawa size was distributed from 21-52 cmFL.".

58. The WPNT **THANKED** the authors of the study for providing this valuable information regarding the catch per unit effort (CPUE) and size distribution of kawakawa (*Euthynnus affinis*) from Indonesia.

59. The WPNT **ENCOURAGED** Indonesia to report information on length frequencies as there is little official data of this type for neritic species in the IOTC database, despite the fact that this data appears to exist. The WPNT **ACKNOWLEDGED** the complications that Indonesia experiences to provide this information, but its utility to the assessment of neritic tuna species was highlighted.

Spatial distribution of frigate tuna in Tanzanian fisheries

60. The WPNT **NOTED** paper IOTC-2018-WPNT08-14 which described the spatial distribution of frigate tuna *auxis thazard* (lacepede, 1800) exploited by artisanal fisheries in Tanzania, including the following abstract provided by the authors:

"Fisheries in Tanzania is dominated by artisan using traditional gears and boats such as dhows,outriggers canoes, nets, movable traps and fixed traps. Fish caught in Tanzanian coastalwaters is primarily consumed on home markets, but the demand is increasing due to theincrease in human population accompanied with the expansion of tourism activities. This study covers five coastal region namely Tanga, Dar es Salaam, Coast, Lindi and Mtwara. A total of 550 individuals of Frigate tuna were analysed in this study. Frigate tuna was most abundant in Lindi by 38.4% of the all Tuna and tuna-like fish caught. The analysis of fish size by month indicated that Frigate tuna in Tanga caught at middle length of 35 cm compared to other sizes. Majority of the individuals caught were observed to fall under the middle length from 35 to 42 cm. This study observed length weight relationship of W=0.001L2.061 in Tanga and W=7.469L3.3889 in Lindi with no significant different between the sexes. The highest CPUE was found in Lindi 12.5kg/Fisher/Day and the lowest was 0.43 kg/Fisher/Day in Mtwara. This paper recommended more effort should be increased on length size data collection for sustainable management of the stock".

61. The WPNT **ACKNOWLEDGED** the efforts by Tanzania to improve their data collection systems and **NOTED** that recent efforts have been made to provide all data for Tanzania combined instead of separated by Zanzibar and mainland. The WPNT also **ACKNOWLEDGED** that a WWF initiative is assisting in improving the data collection and reporting processes and combining the information in a national database, therefore **NOTING** that this should eventually facilitate the reporting of data in the future and complement the little catch-and-effort and size frequency data currently available for Tanzania in the IOTC database.

62. The WPNT **NOTED** that the data is not separated by species for neritic tunas. This makes the interpretation of the information difficult as it is unclear which species are being sampled. It was **SUGGESTED** that Tanzania

should makes efforts to improve the species identification in the samples, as well as increase sampling in order to provide more representative samples for these fisheries.

Data collection and size sampling in Thailand

63. The WPNT **NOTED** paper IOTC–2018–WPNT08–15 which provided a description of the data collection and size sampling of neritic tuna fisheries in Thailand, including the following abstract provided by the authors:

"In the Andaman Sea Coast of Thailand, there are many kinds of fishing gears can catch neritic tuna but most of it were caught by purse seine. The other gears are Otter board trawl, Anchovy falling nets and Squid Falling nets. There are 3 organizations along Andaman sea under Marine Fisheries Research and Development Division responsible to collect the data on fish composition and size distribution, especially for neritic tuna and others importantly economic fish, from more than 10 types of fishing gears. All kind of fishing gears in which both commercial and artisanal fisheries were conducted fisheries data for 3-5 days a month. There are 7 organizations along Andaman sea under Fishing and Fleets Management Division responsible to collected fishing data from logbook and catches landing of marine fish, to recorded and reported the data to Fishing-Info data base. Study on CPUE and MSY were conducted by Fisheries Statistics Analysis and Research Group and Fisheries Resources Assessment Group which are under the Department of Fishery. The purse seine is the mainly fishing gear for pelagic species. Pair trawls and otter board trawls are the main fishing gears for demersal species. The other gears which have a specific name to target species, such as gill nets, hand line and long line. The target species such as Trevallies, Snappers, Barracudas, Croaker, King mackerel, Sharks and Rays. Especially for data collection on Neritic tuna are collected from the purse seine vessel".

64. The WPNT **THANKED** the presenter for the information regarding data collection and size sampling of neritic tunas in Thai fisheries. The WPNT **REQUESTED** clarification regarding the high proportion of small tuna provided for the coastal purse seine fleet, **NOTING** that these purse seine vessels generally target small pelagic species and that IOTC species are generally caught incidentally. This results in predominantly smaller tuna being captured and thus reported.

65. The WPNT **NOTED** that logbooks were only introduced to the fishery in 2015 and that no research effort has yet been made to analyse this for CPUE. The WPNT therefore **URGED** Thailand to investigate the data and evaluate the feasibility of developing a standardised time series of CPUE for neritic tunas caught by coastal purse seine vessels.

Reconstruction of neritic tuna catches in Pakistan

66. The WPNT **NOTED** paper IOTC–2018–WPNT08–17 which provided an overview of neritic tuna catches in Pakistan, including the following abstract provided by the authors:

"Five species of neritic tuna are reported from Pakistan; of these longtail tuna (Thunnus tonggol) contributes 19,143 m. tons during 2017. Landings of frigate tuna (Auxis thazard thazard) during 2017 was recorded to be 13,187 m. tons which is followed by kawakawa (Euthynnus affinis) as 4,199 m. tons. Other two species i.e. bullet tuna (Auxis rochei) and striped bonito (Sarda orientalis) contributed insignificantly in the total tuna landings of Pakistan. During 2017, a major part of the fleet mainly operated in the offshore deeper waters; therefore, landings of neritic tunas were comparatively lesser than previous year".

67. The WPNT **NOTED** the reconstructed catch series of neritic tunas for the Pakistan fleet based on the crew-based observer scheme and **REQUESTED** WWF-Pakistan provide details regarding the methods used to make these substantial revisions.

68. The WPNT **NOTED** the catch trajectory of neritic tunas which has increased over time but decreased markedly in 2017. This is thought to be due to vessels moving offshore to target yellowfin tuna which increased in price over the same time period.

69. The WPNT **NOTED** that Pakistan has stated that gillnet fisheries only operate within the country's EEZ. This presentation provided would seem to indicate that this is not always the case. As such the WPNT **REQUESTED** that Pakistan be contacted to clarify this issue.

70. The WPNT further **NOTED** that the catch trends for the three species described in this presentation closely mimic each other, with the only difference being the total catch levels. The WPNT **AGREED** that this should be further investigated, and an explanation sought for these unusual trends.

9.2 Exploration and analysis of CPC datasets

71. The WPNT examined the Indonesian catch-effort dataset for neritic tuna collected through a port sampling research programme. The WPNT discussed the utility of this dataset for CPUE standardisation and **NOTED** that although the data contain a relatively short time series (i.e. 3 years) for the main gear types, this may still be potentially useful for improving the current catch-only assessment methods for neritic tuna, e.g. to tune the terminal abundance estimates. The WPNT further **NOTED** that data collection is continuing, potentially allowing for longer standardised time series to be developed in the future.

72. The WPNT also discussed the Sri Lanka dataset which contains trip-level catch and effort data from the port sampling programme. The WPNT suggested that a unique trip identifier could be defined or derived for the data to allow for clearer differentiation of fishing event. The WPNT **AGREED** that the ways the data are extracted potentially affect the estimated proportion of zero catches and therefore influence the CPUE standardisation models that can be applied. Using this dataset, the WPNT explored a lognormal standardisation model to kawakawa for the gillnet fishery.

10. PROGRAM OF WORK (RESEARCH AND PRIORITIES)

73. The WPNT **RECALLED** that the SC, at its 17th Session, **REQUESTED** that during the Working Party meetings, each group not only develop a Draft Program of Work for the next five years containing low, medium and high priority projects, but that all High Priority projects are ranked. The intention is that the SC would then be able to review the rankings and develop a consolidated list of the highest priority projects to meet the needs of the Commission. Where possible, budget estimates should be determined, as well as the identification of potential funding sources (SC17 Para.178).

10.1 Revision of the WPNT Program of Work (2019–2023)

74. The WPNT **NOTED** paper IOTC-2018-WPNT08-08 providing an outline of the programme of work for 2019 – 2023.

75. The WPNT **NOTED** the low number of participants from CPCs at the current workshop (six excluding the Chair and Vice-Chair) partly due to the technical and specialised focus of the meeting, and **RECOMMENDED** that future capacity building actions and specialised workshops are conducted back-to-back with the regular Working Party meetings so that each CPC can send their most appropriate scientists to the WPs / Workshops.

76. The WPNT **AGREED** that the meeting in 2019 should focus on data mining and collation as this is a fundamental piece of work to be undertaken as a priority, and this meeting will serve as a data-preparatory meeting for the assessments to be conducted in 2020.

77. The WPNT **RECOMMENDED** that the Commission allocates funding for a consultancy to support the CPCs identified in Appendix VI with CPUE standardisation for the priority species identified.

78. The WPNT **UPDATED** Table 7 providing an overview of the datasets available for key CPCs catching neritic tuna species and **ENCOURAGED** CPCs to make these data available for stock assessment purposes.

Table 2. Neritic tuna datasets by CPC

CPC	Fishery	Logbook data	Port sampling data	Contact Organisation
Thailand	Coastal Seine	2015 - present	>10 years	Department of Fisheries, Thailand
Malaysia	Seine/trawl/gillnet	-	1980 - present	nor_azlin@dof.gov.my
Indonesia	Line/seine	2013-2016	2014-2016	Directorate General Capture Fisheries (DGCF) Ministry of Marine Affairs and Fisheries of Indonesia.
Oman	Artisanal fleet (unspecified gear types)	-	1984 - present	
I.R. Iran	Gillnet	GN >10 years	2013 - present	IFO
Sri Lanka	Gillnet/ Longline/ring net/other	2015-present (2016 data more precise)	>10 years	NARA/ DFAR
Maldives		Very recent (2004-2015 exist but quality uncertain)		MRC
India	Gillnet/seine/trawls/ Artisanal gears		>10 years	CMFRI
Tanzania	Artisanal	1980s		
Mozambique	Artisanal			Fisheries Research Institute (IIP)

Kenya	Sport fisheries data	> 10 years		Kenya Fisheries Services
Pakistan	Gillnet fleet	[2]	1985-1995; 2012	Marine Fisheries Department, Govt. Pakistan

79. The WPNT **RECOMMENDED** that the SC consider and endorse the WPNT Program of Work (2019–2023), as provided in Appendix VI.

11. Other Business

11.1 Development of priorities for an Invited Expert at the next WPNT meeting

80. The WPNT **AGREED** to the following core areas of expertise and priority areas for contribution that need to be enhanced for the next meeting of the WPNT in 2019, by an Invited Expert:

1) data poor assessment approaches (e.g. catch only methods, Bayesian approaches);
2) stock structure/connectivity; including from regions other than the Indian Ocean;

81. The WPNT **NOTED** with thanks the excellent contributions of both the invited expert for the meeting, Dr Shijie Zhou (CSIRO, Australia) and the course facilitator, Dr Rui Coelho (IPMA, Portugal), in support of the CPUE workshop.

11.2 Date and place of the 9th and 10th Working Party on Neritic Tunas

82. The WPNT **NOTED** that Sri Lanka expressed interest in potentially hosting the 9th Session of the WPNT and **RECOMMENDED** the SC consider as preferred dates of either the last week of June or the first week of July 2019. The WPNT further **NOTED** that Kenya have expressed interest in potentially hosting the 10th Session of the WPNT in 2020 with dates yet to be agreed.

Meeting participation fund (MPF)

83. The WPNT participants were unanimous in their thanks for the support for their participation in the meeting due to the MPF and **RECOMMENDED** that the Scientific Committee also consider the WPNT09 as a high priority meeting for MPF.

84. The WPNT **RECOMMENDED** that the SC and Commission note the following:

4) The participation of developing coastal state scientists to the WPNT has been consistently high following the adoption and implementation of the IOTC Meeting Participation Fund adopted by the Commission in 2010 (Resolution 10/05 *On the establishment of a Meeting Participation Fund for developing IOTC Members and Non-Contracting Cooperating Parties*), now incorporated into the IOTC Rules of Procedure (2014), as well as though the hosting of the WPNT in developing coastal State Contracting Parties (Members) of the Commission (Table 8).
5) The continued success of the WPNT, at least in the short term, appears heavily reliant on the provision of support via the MPF which was established primarily for the purposes of supporting scientists to attend and contribute to the work of the Scientific Committee and its Working Parties.
6) The MPF should be utilised so as to ensure that all developing Contracting Parties of the Commission are able to attend the WPNT meeting, as neritic tunas are very important resources for many of the coastal countries of the Indian Ocean.

Table 3. Working Party on Neritic Tunas participation summary.

Meeting	Host Country	Total participants	Developing CPC participants	Host country participants	MPF recipients
WPNT01	India	28	23	11	9
WPNT02	Malaysia	35	26	13	10
WPNT03	Indonesia	42	34	16	11
WPNT04	Thailand	37	28	12	13
WPNT05	Tanzania	26	26	16	9
WPNT06	Seychelles	20	12	0	8

[2] Crew based observer data available from 2013 to present on request from Govt. of Pakistan, collected by WWF-Pakistan.

WPNT07	Maldives	26	18	5	13
WPNT08	Seychelles	18	8	0	7
Total		204	152	62	71

11.3 Review of the draft, and adoption of the Report of the 8th Working Party on Neritic Tunas

85. The WPNT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPNT08, provided at Appendix XIII, as well as the management advice provided in the draft resource stock status summary for each of the six neritic tuna (and mackerel) species under the IOTC mandate, and the combined Kobe plot for the species assigned a stock status in 2018 (Fig. 1):

- Bullet tuna (*Auxis rochei*) – Appendix VII
- Frigate tuna (*Auxis thazard*) – Appendix VIII
- Kawakawa (*Euthynnus affinis*) – Appendix IX
- Longtail tuna (*Thunnus tonggol*) – Appendix X
- Indo-Pacific king mackerel (*Scomberomorus guttatus*) – Appendix XI
- Narrow-barred Spanish mackerel (*Scomberomorus commerson*) – Appendix XII

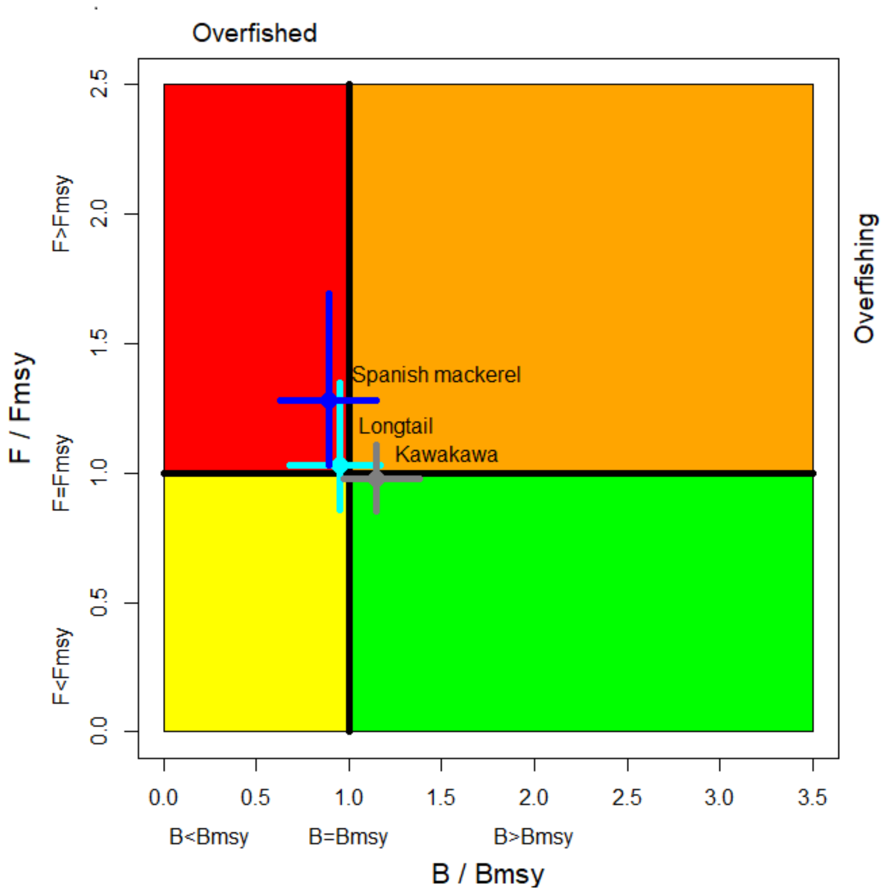

Fig. 1. Combined Kobe plot for longtail tuna, narrow-barred Spanish mackerel and kawakawa, showing the estimates of stock size (B) and current fishing mortality (F) in 2015 in relation to optimal spawning stock size and optimal fishing mortality. Cross bars illustrate the range of uncertainty from the model runs.

86. The report of the 8th Session of the Working Party on Neritic Tunas (IOTC–2018–WPNT08–R) was **ADOPTED** on the 24 August 2018.

APPENDIX I
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APPENDIX II

AGENDA FOR THE 8TH WORKING PARTY ON NERITIC TUNAS

Date: 21–24 August 2018
Location: Mahé, Seychelles
Venue: tbc
Time: 09:00 – 17:00 daily
Chair: Dr Farhad Kaymaram; **Vice-Chair**: Dr Mathias Igulu

1. **OPENING OF THE MEETING** (Chair) Day 1

2. **ADOPTION OF THE AGENDA AND ARRANGEMENTS FOR THE SESSION** (Day 1 - am)

3. **THE IOTC PROCESS: OUTCOMES, UPDATES AND PROGRESS** (Day 1 - am)
   - 3.1 Progress on the recommendations of WPNT07 (SC20 and S22)

4. **NEW STATISTICAL INFORMATION ON FISHERIES FOR NERITIC TUNAS** (Day 1 - am)
   - 4.1 Review of the statistical data available for neritic tunas

5. **CPUE: SETTING THE SCENE** (Day 1 - am)
   - 5.1 General introduction to CPUE (context, importance for stock assessments, why standardisation is necessary)
   - 5.2 Summary of IOTC work on CPUE undertaken to-date and use of this (WPTT, WPB, WPEB)

6. **INTRODUCTION TO R** (Day 1 - pm)
   - 6.1 Getting data into R
   - 6.2 Data exploration

7. **STATISTICAL MODELS** (Day 2 – am)
   - 7.1 Introduction to statistical models: LMs, GLMs and GAMS (including model assumptions, distributions and model fitting, variable selection, model validation, diagnostics etc)

8. **CPUE STANDARDISATION** (Day 2 - pm to Day 3 - am)
   - 8.1 Examples of CPUE standardisation (NOAA LL-SIM datasets):
     - Lognormal + constant
     - Delta-lognormal
     - Tweedie

9. **CPC DATASETS** (Day 3 - pm)
   - 9.1 Review of CPUE information on neritic tuna fisheries (CPC papers)
   - 9.2 Exploration and analysis of CPC datasets (Day 4 - am)

10. **PROGRAM OF WORK (RESEARCH AND PRIORITIES)** (Day 4 - pm)
    - 10.1 Revision of the WPNT Program of Work 2019–2023 (Chair)
    - 10.2 Development of priorities for an Invited Expert at the next WPNT meeting

11. **OTHER BUSINESS** (Day 4 - pm)
    - 11.1 Date and place of the 9th and 10th Working Party on Neritic Tunas (Chair)
    - 11.2 Review of the draft, and adoption of the Report of the 8th Working Party on Neritic Tunas (Chair) (Day 4 – pm)

APPENDIX III
LIST OF DOCUMENTS

Document	Title	Availability
IOTC–2018–WPNT07–01a	Draft: Agenda of the 8th Working Party on Neritic Tunas	✓ 7 March 2018 ✓ 26 June 2018
IOTC–2018–WPNT07–01b	Annotated agenda of the 8th Working Party on Neritic Tunas	✓ 26 June 2018
IOTC–2018–WPNT07–02	List of documents of the 8th Working Party on Neritic Tunas	✓ 26 June 2018
IOTC–2018–WPNT08–03	Outcomes of the 20th Session of the Scientific Committee (IOTC Secretariat)	✓ 26 June 2018
IOTC–2018–WPNT08–04	Outcomes of the 22nd Session of the Commission (IOTC Secretariat)	✓ 26 June 2018
IOTC–2018–WPNT08–05	Review of current Conservation and Management Measures relating to neritic tuna species (IOTC Secretariat)	✓ 26 June 2018
IOTC–2018–WPNT08–06	Progress made on the recommendations and requests of WPNT07 and SC20 (IOTC Secretariat)	✓ 26 June 2018
IOTC–2018–WPNT08-07	Review of the statistical data available for the neritic tuna species (IOTC Secretariat)	✓ 18 August 2018
IOTC–2018–WPNT08–08	Revision of the WPNT Program of Work (2019–2023) (IOTC Secretariat)	✓ 26 June 2018
IOTC–2018–WPNT08–09	Catch efficiency of gillnets for kingfish (*Scomberomorus commerson*) fishery in Iranian coastal waters of Persian Gulf and Oman Sea	withdrawn
IOTC–2018–WPNT08–10	Assessment of artisanal fishing gears impact on king fish (*Scomberomorus commerson*) in the Kenyan marine ecosystem	✓ 6 August 2018
IOTC–2018–WPNT08–11 Rev_1	Relationship between frigate tuna (*Auxis thazard*) Catch Per Unit Effort (CPUE) and fishing operation related parameters: A case study in tuna fishery of Sri Lanka	✓ 6 August 2018 ✓ 13 August 2018
IOTC–2018–WPNT08–12	Catch and effort of neritic tuna in Comoros from 2011 to 2015	✓ 6 August 2018
IOTC–2018–WPNT08–13	Catch per unit effort (CPUE) and size distribution of kawakawa (*Euthynnus affinis*) from Indonesia fisheries management area (FMA) 573	✓ 21 August 2018
IOTC–2018–WPNT08–14	Spatial distribution of frigate tuna *Auxis thazard* (lacepede, 1800) exploited from artisanal catch in Tanzania mainland	✓ 23 August 2018
IOTC–2018–WPNT08–15	Data collection and size sampling on neritic tuna fisheries in Andaman Sea (K.Maeroh, S.Hoi,uk, S.Inthong and S. Rodpradit)	✓ 6 August 2018
IOTC-2018-WPNT08-16	A study of Neritic tuna data collection system in Iran fishery management process	withdrawn
IOTC-2018-WPNT08-17	Status of neritic tuna fisheries of Pakistan	✓ 6 August 2018
Information papers		
IOTC-2018-WPNT08- INF01	Guidelines for CPUE	✓ 6 August 2018
IOTC-2018-WPNT08- INF02	Workplan of the Scientific Committee	✓ 6 August 2018
Data sets		
IOTC-2018-WPNT08-DATA01	IOTC Neritic tuna datasets available	✓ 14 August 2018
IOTC-2018-WPNT08-DATA02	IOTC Species data catalogues – availability of data	✓ 14 August 2018
IOTC-2018-WPNT08-DATA03	Nominal catches per Fleet, Year, Gear, IOTC Area andspecies	✓ 14 August 2018
IOTC-2018-WPNT08-DATA04	Catch and effort data - vessels using drifting longline	✓ 14 August 2018
IOTC-2018-WPNT08-DATA05	Catch and effort data - vessels using pole and lines or purse seines	✓ 14 August 2018
IOTC-2018-WPNT08-DATA06	Catch and effort data - vessels using other gears (e.g., gillnets, lines and unclassified gears)	✓ 14 August 2018

Document	Title	Availability
IOTC-2018-WPNT08-DATA07	Catch and effort data - all gears	✓ 14 August 2018
IOTC-2018-WPNT08-DATA08	Catch and effort – reference file	✓ 14 August 2018
IOTC-2018-WPNT08-DATA09_Rev1	Size frequency data - neritic tunas	✓ 14 August 2018 ✓ 16 August 2018
IOTC-2018-WPNT08-DATA10_Rev1	Size frequency – reference file	✓ 14 August 2018 ✓ 16 August 2018
IOTC-2018-WPNT08-DATA11	Equations used to convert from fork length to round weight for neritic tuna species	✓ 14 August 2018

APPENDIX IVA
MAIN STATISTICS FOR BULLET TUNA (*AUXIS ROCHEI*)

Extract from IOTC–2018–WPNT08–07

Fisheries and main catch trends

- Main fisheries: bullet tuna is mainly caught using gillnets, handlines and trolling, across the broader Indian Ocean area. This species is also an important catch for coastal purse seiners (**Table 4; Fig.19**).
- Main fleets (i.e., in terms of highest catches in recent years):
  Catches are highly concentrated: in recent years over 90% of catches in the Indian Ocean have been accounted for by fisheries in India, Sri Lanka, Indonesia (**Fig.20**).
- Retained catch trends:
  Estimated catches of bullet tuna reached around 2,000 t in the early 1990's, increasing markedly in the following years to reach a peak in 1997, at around 4,900 t. The catches decreased slightly in the following years and remained at values of between 3,700 t and 4,000 t until the late-2000's, increasing sharply again up to the 10,000 t recorded in 2010, the highest catch ever recorded for this species in the Indian Ocean.
- Discard levels: are moderate for industrial purse seine fisheries. The EU recently reported discard levels of bullet tuna for its purse seine fleet, for 2003–07, estimated using observer data.

***Changes to the catch series*:** There have been no major changes to the catch series of bullet tuna since the WPNT meeting in 2017.

Bullet tuna – estimation of catches: data related issues

Retained catches for bullet tuna were derived from incomplete information, and are therefore uncertain[3] (**Fig.21**), due to:

- Aggregation: Bullet tunas are usually not reported by species, but are instead aggregated with frigate tunas or, less frequently, other small tuna species.
- Mislabelling: Bullet tunas are usually mislabelled as frigate tuna, with their catches reported under the latter species.
- Underreporting: the catches of bullet tuna by industrial purse seiners are rarely, if ever, reported.

For the reasons listed above the catches of bullet tunas in the IOTC database are thought to be highly uncertain and represent only a small fraction of the total catches of this species in the Indian Ocean.

[3] The uncertainty in the catch estimates has been assessed by the Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of non-reporting fisheries for which catches had to be estimated.

TABLE 4. Bullet tuna: scientific estimates of catches of bullet tuna by type of fishery for the period 1950–2017 (in metric tonnes).

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Purse seine	-	-	28	278	552	655	908	1,055	1,372	635	549	513	2,512	2,994	2,065	1,956
Gillnet	41	153	296	531	1,222	1,741	2,236	2,587	3,347	2,692	2,830	2,724	3,125	2,955	2,703	2,638
Line	113	193	325	393	780	1,190	1,858	2,182	2,903	1,162	1,078	1,054	1,290	3,277	4,635	4,449
Other	5	13	44	242	755	1,322	1,638	2,022	2,748	3,905	4,503	4,597	1,256	1,290	1,714	2,052
Total	**159**	**360**	**693**	**1,444**	**3,309**	**4,907**	**6,640**	**7,847**	**10,370**	**8,394**	**8,960**	**8,888**	**8,182**	**10,516**	**11,116**	**11,094**

Definition of fishery: Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline, longline fresh, trawling.

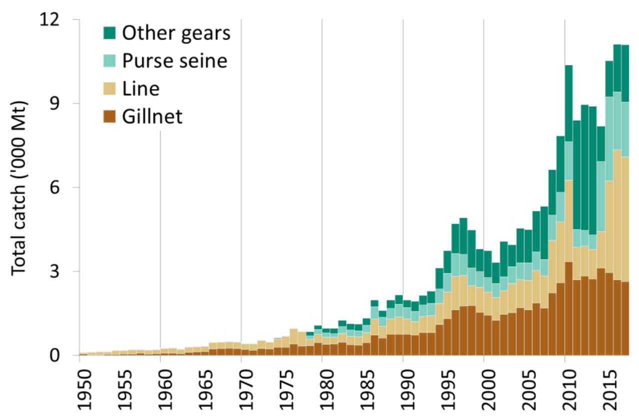


Fig.19. Bullet tuna: Annual catches by gear recorded in the IOTC Database (1950–2017).

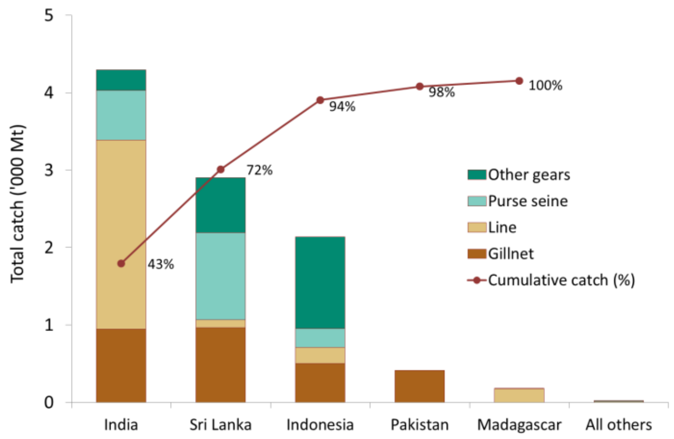


Fig.20. Bullet tuna: Average catches in the Indian Ocean over the period 2013–17 by country[4].

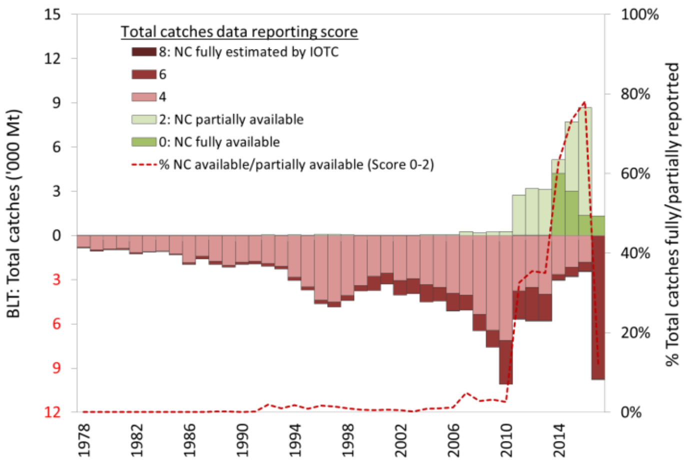


Fig.21. Bullet tuna: nominal catch; uncertainty of annual catch estimates (1978–2017).

Catches are assessed against IOTC reporting standards, where a score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2 – 6 do not report catch data fully by gear and/or species (i.e., partially adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; catches with a score of 8 refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat).

**** Note: The high proportion of catches estimated in 2017 are due to partial data submission by Indonesia and non-reporting by India.***

[4] Countries are ordered from left to right, according to the importance of catches of longtail reported for 2013-2017. The red line indicates the (cumulative) proportion of catches of longtail tuna for the countries concerned, over the total combined catches of this species reported from all countries and fisheries for 2013-2017.

Bullet tuna – Effort trends

- Availability: Effort trends are unknown for bullet tuna in the Indian Ocean, due to a lack of catch-and-effort data.

Bullet tuna – Catch-per-unit-effort (CPUE) trends

- Availability: highly incomplete, and, when available, are considered to be of poor quality for the fisheries having reasonably long catch-and-effort data series – as is the case with the gillnet fisheries of Sri Lanka (**Fig.22**).
- Main CPUE series available: Sri Lanka (gillnets) (**Fig.23**).

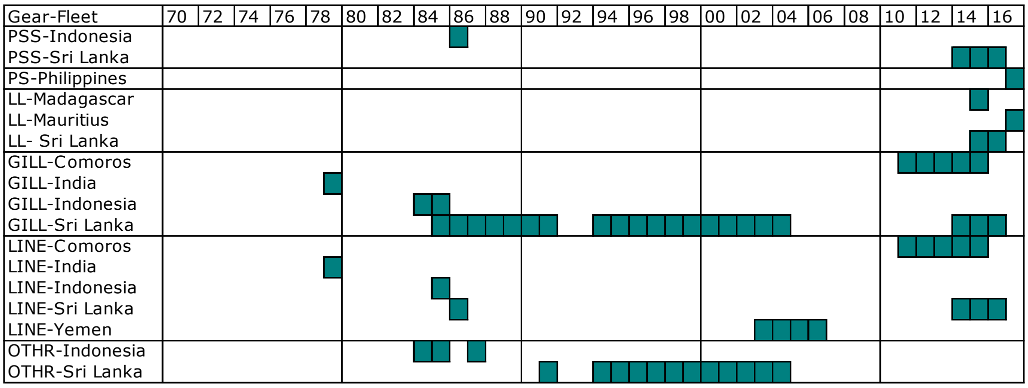


Fig.22. Bullet tuna: Availability of catches and effort series, by fishery and year (1970–2017)[5]. Note that no catches and effort are available at all for 1950–78.

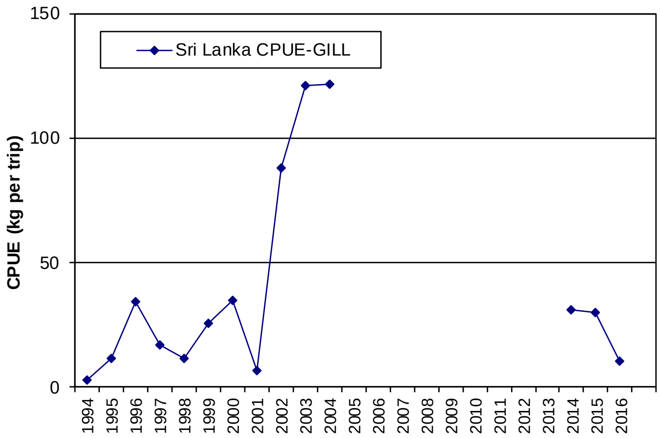


Fig.23. Bullet tuna: Nominal CPUE series for the gillnet fishery of Sri Lanka derived from the available catches and effort data (1994–2004 and 2014-2016).

Bullet tunas – Fish size or age trends (e.g., by length, weight, sex and/or maturity)

- Sizes: Fisheries catching bullet tuna in the Indian Ocean tend to catch specimens ranging between 15 and 35 cm.
- Size frequency data: highly incomplete, with data only available for selected years and/or fisheries (**Fig.24**).

  Main sources for size samples: Sri Lanka (gillnet and trolling).
  Total numbers of samples, across all years, are also well below the minimum sampling standard of 1 fish per tonne of catch recommended by the IOTC Secretariat to reliably assess changes in average weight.

[5] Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, when available catches and effort may not be available throughout the year existing only for short periods

- Catch-at-Size (Age) table: Not available due to lack of size samples and uncertainty over the reliability of retained catch estimates.
- Sex ratio data: have not been provided to the Secretariat by CPCs.

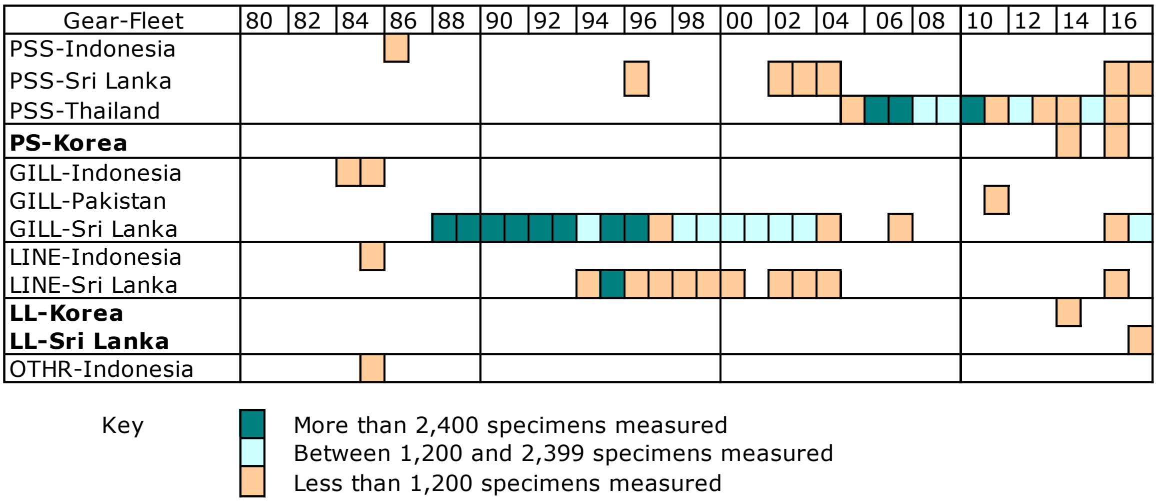


Fig. 24. Bullet tuna: Availability of length frequency data, by fishery and year (1980–2017)[6]. Note that no length frequency data are available at all for 1950–83.

Other biological data: Equations available for bullet tuna are shown below:

Species	From type measurement – To type measurement	Equation	Parameters	Sample size	Length
Bullet tuna	Fork length – Round Weight	RND=a*L^b	a= 0.00001700 b= 3.0		Min:10 Max:40

Source: Data from North Indian Ocean: IPTP Sampling Programme in Sri Lanka (1989).

[6] Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, when available size data may not be available throughout the year existing only for short periods

APPENDIX IVB
MAIN STATISTICS FOR FRIGATE TUNA (*AUXIS THAZARD*)

Extract from IOTC–2018–WPNT08–07

Fisheries and main catch trends

- Main fisheries: frigate tuna is mainly caught using gillnets, coastal longline and trolling, handlines and trolling, and to a lesser extent coastal purse seine nets (**Table 3; Fig.12**). The species is also an important bycatch for industrial purse seine vessels and is the target of some ring net fisheries (recorded as purse seine in Table 3).
- Main fleets (i.e., highest catches in recent years):

  Catches of frigate tuna are highly concentrated: Indonesia accounts for around two-thirds of catches, while over 90% of catches are accounted for by four countries (Indonesia, I.R. Iran, India, Sri Lanka) (**Fig.13**).
- Retained catch trends:
  Estimated catches have increased steadily since the late-1970's, reaching around 30,000 t in the late-1980's, to between 55,000 and 60,000 t by the mid-1990's, and remaining at the same level in the following ten years. Between 2010 and 2014 catches have increased to over 95,000 t, rising to the highest levels recorded.
- Discard levels**:** are moderate for industrial purse seine fisheries. In previous years the EU has reported discard levels of frigate tuna for its purse seine fleet, for 2003–07, estimated using observer data.

***Changes to the catch series*:** there have been no major changes to the catch series of frigate tuna since the WPNT meeting in 2017.

Frigate tuna: estimation of catches – data related issues

Retained catches for frigate tuna were derived from incomplete information, and are therefore uncertain[7] (**Fig.14**), notably for the following fisheries:

- Artisanal fisheries of Indonesia: Indonesia did not report catches of frigate tuna by species or by gear for 1950–2004; catches of frigate tuna, bullet tuna and other species were reported aggregated for this period. In the past, the IOTC Secretariat used the catches reported since 2005 to break the aggregates for 1950–2004, by gear and species. However, in a recent review by the IOTC Secretariat conducted by an independent consultant in 2012 he indicated that the catches of frigate tuna had been underestimated by Indonesia. While the new catches estimated for the frigate tuna in Indonesia remain uncertain, the new figures are considered more reliable than those existing in the past.
- Artisanal fisheries of India and Sri Lanka: Although these countries report catches of frigate tuna, until recently the catches have not been reported by gear. The catches of both countries were also reviewed by an independent consultant in 2012 and assigned by gear on the basis of official reports and information from various other alternative sources. The new catch series was previously presented to the WPNT in 2013, in which the new catches estimated for Sri Lanka are as much as three times higher than compared to previous estimates.
- Artisanal fisheries of Myanmar and Somalia: None of these countries have ever reported catches of frigate tuna to the IOTC Secretariat, and catch levels are highly uncertain. In the case of Myanmar, catches are taken from FAO and SEAFDEC (various years).
- Other artisanal fisheries: The catches of frigate tuna and bullet tuna are seldom reported by species and, when they are reported by species, usually refer to both species (due to species misidentification or commercial categories used within countries, with all catches often assigned as frigate tuna).
- Industrial fisheries: The catches of frigate tuna recorded for industrial purse seiners are thought to be a fraction of those retained on board. Due to this species being a bycatch, catches of frigate tuna are seldom recorded in the

[7] The uncertainty in the catch estimates has been assessed by the Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of non-reporting fisheries for which catches had to be estimated.

logbooks, nor can they be monitored in port. Currently the only discards data for frigate tuna reported to the IOTC Secretariat refer to the EU purse seine fleet, for 2003–07, estimated using observer data.

TABLE 3. Frigate tuna: Best scientific estimates of the catches of frigate tuna by type of fishery for the period 1950–2017 (in metric tonnes). Data as of August 2018.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Purse seine	-	15	824	4,664	7,550	10,021	9,501	9,663	12,044	11,636	10,362	10,264	12,602	9,047	10,120	8,537
Gillnet	487	1,241	2,837	6,948	14,519	20,257	24,414	24,082	31,277	30,524	31,470	29,924	37,545	29,075	27,940	27,682
Line	1,264	2,407	4,419	7,432	13,753	27,083	30,474	34,591	37,840	37,510	36,245	39,331	34,233	31,816	28,368	26,715
Other	1,441	2,007	2,349	3,683	9,276	13,670	15,193	18,112	18,550	18,934	17,649	18,766	13,298	12,442	11,128	11,752
Total	**3,192**	**5,671**	**10,428**	**22,728**	**45,099**	**71,031**	**79,582**	**86,448**	**99,710**	**98,604**	**95,725**	**98,284**	**97,678**	**82,381**	**77,556**	**74,686**

Definition of fishery: Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline, longline fresh, trawling.

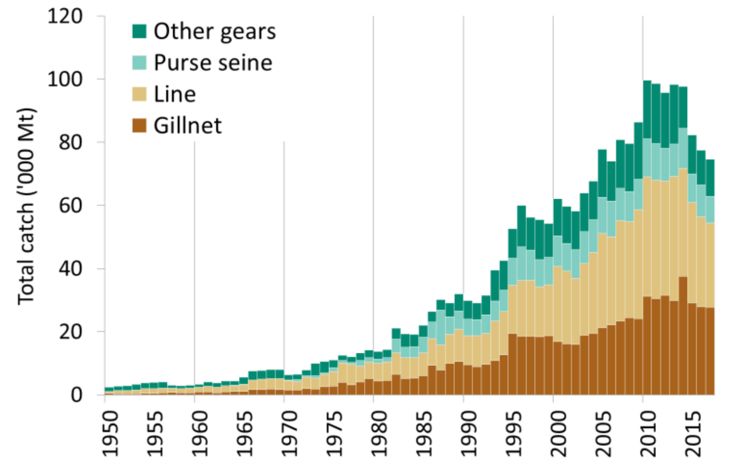


Fig.12. Frigate tuna: Annual catches by gear recorded in the IOTC Database (1950–2017).

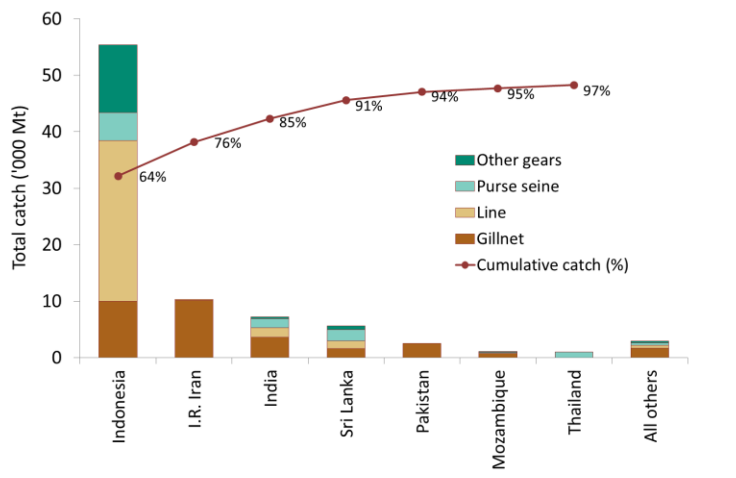
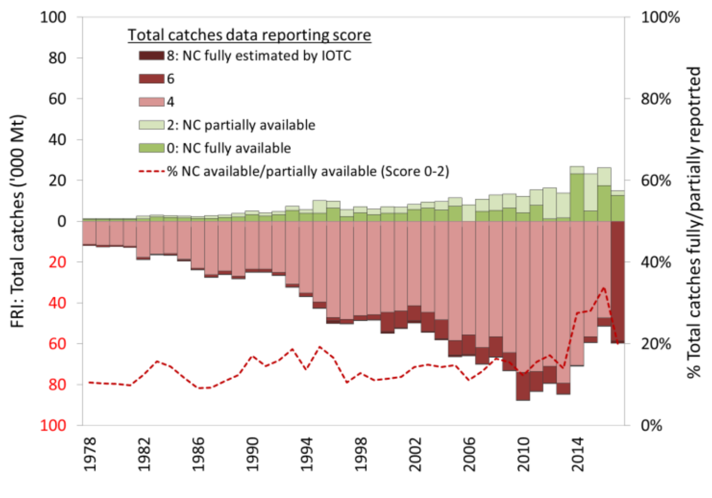


Fig.13. Frigate tuna: Average catches in the Indian Ocean over the period 2013–17, by country[8].



[8] Countries are ordered from left to right, according to the importance of catches of longtail reported for 2013-2017. The red line indicates the (cumulative) proportion of catches of longtail tuna for the countries concerned, over the total combined catches of this species reported from all countries and fisheries for 2013-2017.

Fig.14. Frigate tuna: nominal catch; uncertainty of annual catch estimates (1978–2017).

Catches are assessed against IOTC reporting standards, where a score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2 – 6 do not report catch data fully by gear and/or species (i.e., partially adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; catches with a score of 8 refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat).

**** Note: The high proportion of catches estimated in 2017 are due to partial data submission by Indonesia and non-reporting by India.***

Frigate tuna – Effort trends

- Availability: Effort trends are unknown for frigate tuna in the Indian Ocean, due to a lack of catch-and-effort data.

Frigate tuna – Catch-per-unit-effort (CPUE) trends

- Availability: highly incomplete, although data are available for short periods of time (e.g., more than 10 years) for selected fisheries (**Fig.15**).
- Main CPUE series available: Sri Lanka (gillnets), and Maldives (pole and line, hand and troll lines) (**Fig.16**). However the quality of catch-and-effort recorded for Sri Lankan gillnets are thought to be low due to large changes in the CPUE between consecutive years.

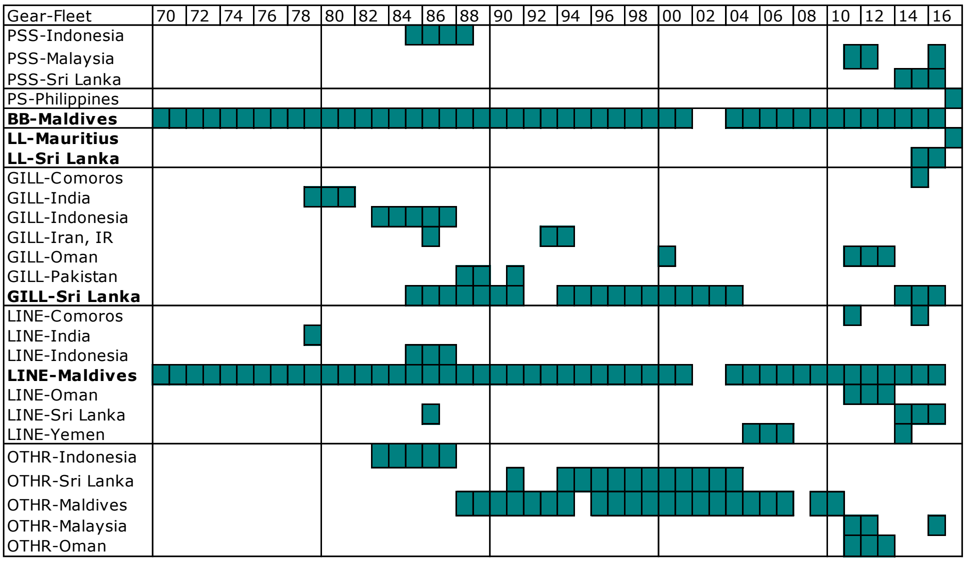


Fig. 15. Frigate tuna: Availability of catches and effort series, by selected fishery and year (1970–2017)[9]. Note that no catch-and-effort data are available for 1950–69.

[9] Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, when available catches and effort may not be available throughout the year existing only for short periods

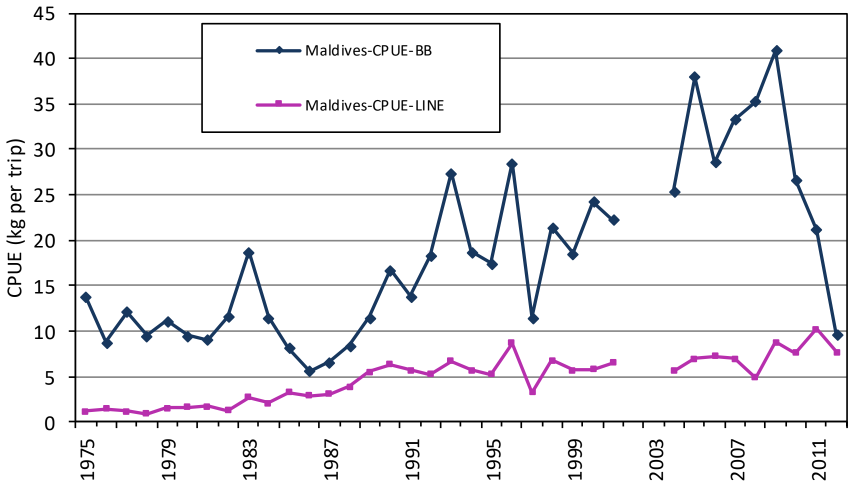


Fig.16. *Frigate tuna: Nominal CPUE series for the baitboat (BB using mechanized boats) and line (LINE, including handlines and trolling using mechanized boats) fisheries of Maldives derived from the available catches and effort data (1975–2016). Data since 2013 has been reported as fishing days (rather than as fishing trips for data up to 2013).*

Frigate tunas – Fish size or age trends (e.g., by length, weight, sex and/or maturity)

- Sizes: the sizes of frigate tunas taken by Indian Ocean fisheries typically range between 20 – 50 cm depending on the type of gear used, season and location. Fisheries operating in the Andaman Sea (coastal purse seines and troll lines) tend to catch frigate tuna of small to medium size (15–40 cm) while the gillnet, baitboat and other fisheries operating in the Indian Ocean catch usually larger specimens (25–50 cm).

- Size frequency data: highly incomplete, with data only available for selected years and/or fisheries (**Fig.17**).

  Main sources for size samples: Sri Lanka (gillnet) and Thailand (coastal purse seiners).
  Length distributions derived from data available for gillnet fisheries are shown in **Fig.18**. Generally speaking total numbers of samples are below the minimum sampling standard of 1 fish per tonne of catch recommended by the IOTC Secretariat to reliably assess changes in average weight – with the exception of samples recorded for Sri Lanka gillnets during the mid-1980s to early-1990, which were obtained with the support of IPTP funding.
- Catch-at-Size (Age) table: Not available, due to lack of size samples and uncertainty over the reliability of retained catch estimates.

- Sex ratio data: have not been provided to the Secretariat by CPCs.

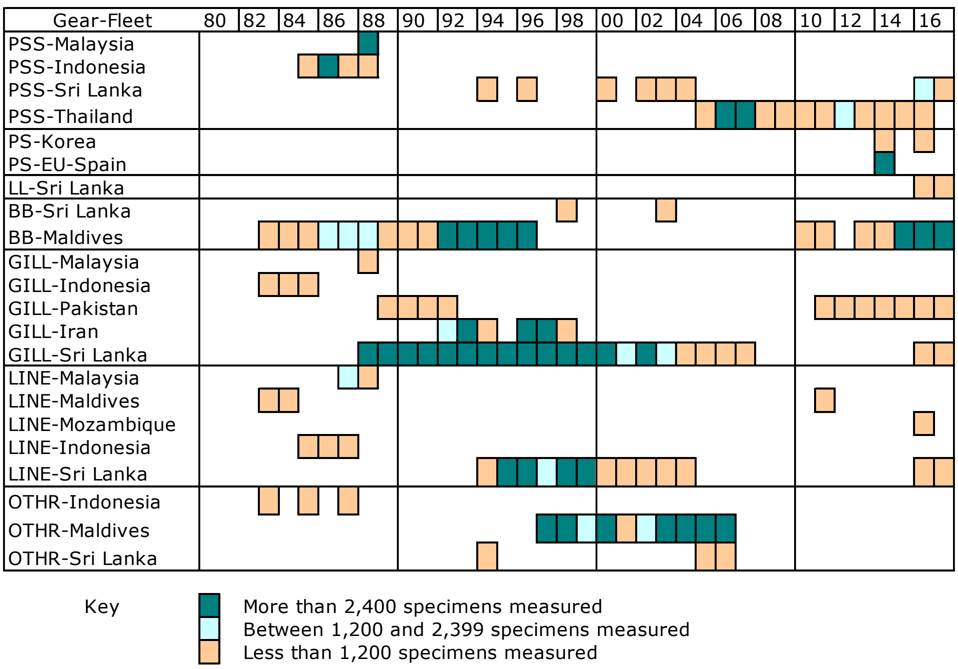


Fig.17. Frigate tuna: Availability of length frequency data, by fishery and year (1980–2017)[10]. Note that no length frequency data are available at all for 1950–82.

Other biological data: Equations available for frigate tuna are shown below:

Species	From type measurement – To type measurement	Equation	Parameters	Sample size	Length
Frigate tuna	Fork length – Round Weight	RND=a*L^b	a= 0.00001700 b= 3.0		Min:20 Max:45

Source: Data from Indian Ocean: IOTC-2011-WPNT01-10 Tuna Fishery of India with Special Reference to Biology and Population Characteristics of Neritic Tunas Exploited from Indian EEZ.

[10] Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, when available size data may not be available throughout the year existing only for short periods

APPENDIX IVC
MAIN STATISTICS FOR KAWAKAWA (*EUTHYNNUS AFFINIS*)

Extract from IOTC–2018–WPNT08–07

Fisheries and main catch trends

- Main fisheries: Kawakawa are caught mainly by, gillnets, handlines and trolling, and coastal purse seiners, and may be also an important bycatch of the industrial purse seiners (**Table 5; Fig.25**).
- Main fleets (i.e., highest catches in recent years): Indonesia, India, I.R. Iran, and Pakistan (**Fig.26**).
- Retained catch trends:
  Annual estimates of catches for the kawakawa increased markedly from around 20,000 t in the mid-1970's to reach the 45,000 t mark in the mid-1980's to over 155,000 t in recent years (since 2011), the highest catches ever recorded for this species.
- Discard levels: are moderate for industrial purse seine fisheries. In recent years the EU has reported discard levels of kawakawa for its purse seine fleet, for 2003–07, estimated using observer data.

***Changes to the catch series*:** There have been no major revisions to the catch series for kawakawa since the WPNT meeting in 2017.

Kawakawa tuna – estimation of catches: data related issues

Retained catches for kawakawa were derived from incomplete information, and are therefore uncertain[11] (**Fig.27**), notably for the following fisheries:

- Artisanal fisheries of Indonesia: Indonesia did not report catches of kawakawa by species or by gear for 1950–2004; catches of kawakawa, longtail tuna and, to a lesser extent, other species were reported as species aggregates for this period. In the past, the IOTC Secretariat used the catches reported since 2005 to break the aggregates for 1950–2004, by gear and species. A review by the IOTC Secretariat conducted by an independent consultant in 2012 indicated that the catches of kawakawa had been overestimated by Indonesia. While the new catches estimated for kawakawa in Indonesia remain uncertain, the new figures are considered more reliable than those previously recorded in the IOTC database – while fundamental issues remain with the quality of official catches reported by Indonesia to the IOTC Secretariat (e.g., unexplained fluctuations in catches by species between years, as well as large revisions in catches).
- Artisanal fisheries of India: Although India reports catches of kawakawa they are not always reported by gear. The catches of kawakawa in India were also reviewed by the IOTC Secretariat in 2012 and assigned by gear on the basis of official reports and information from various other alternative sources.
- Artisanal fisheries of Myanmar and Somalia: None of these countries have ever reported catches to the IOTC Secretariat. Catch levels are unknown.
- Other artisanal fisheries: The catches of kawakawa are usually not reported by species, being combined with catches of other small tuna species like skipjack tuna and frigate tuna (e.g., coastal purse seiners of Thailand, and until recently Malaysia).
- Industrial fisheries: The catches of kawakawa recorded for industrial purse seiners are thought to be a fraction of those retained on board. Due to this species being a bycatch, its catches are seldom recorded in the logbooks, nor are they monitored in port. The EU recently reported catch levels of frigate tuna for its purse seine fleet, for 2003–07, estimated using observer data.

[11] The uncertainty in the catch estimates has been assessed by the Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of non-reporting fisheries for which catches had to be estimated.

TABLE 5. Kawakawa: Best scientific estimates of the catches of kawakawa by type of fishery for the period 1950–2017 (in metric tonnes). Data as of August 2018.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Purse seine	110	385	2,616	12,070	21,396	28,613	32,441	37,051	35,064	44,892	42,700	42,124	38,613	40,392	35,547	41,155
Gillnet	2,567	4,488	9,691	17,959	30,709	53,510	70,785	69,593	64,507	74,762	75,914	85,986	84,191	75,685	80,530	86,585
Line	1,711	3,260	6,642	9,865	15,673	19,911	22,710	23,983	23,562	25,785	32,344	28,983	24,893	29,748	27,061	24,601
Other	295	719	1,357	2,690	5,127	7,819	9,015	10,129	9,994	10,007	9,976	10,255	8,052	7,081	7,605	7,410
Total	**4,684**	**8,852**	**20,306**	**42,583**	**72,905**	**109,853**	**134,952**	**140,756**	**133,127**	**155,446**	**160,934**	**167,348**	**155,750**	**152,906**	**150,743**	**159,752**

Definition of fishery: Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline, longline fresh, trawling.

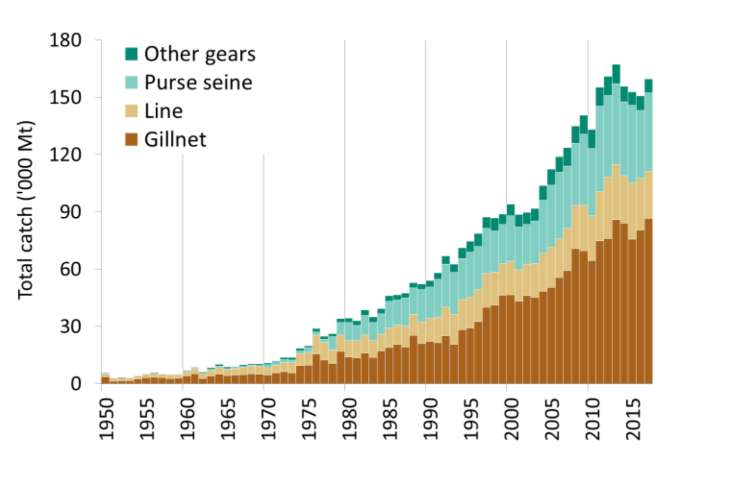


Fig.25. Kawakawa: Annual catches by gear recorded in the IOTC Database (1950–2017).

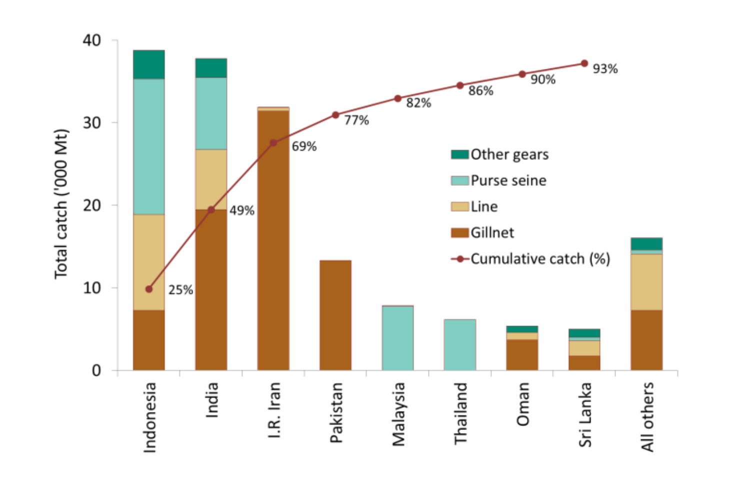


Fig.26. Kawakawa: Average catches in the Indian Ocean over the period 2013–17, by country[12].

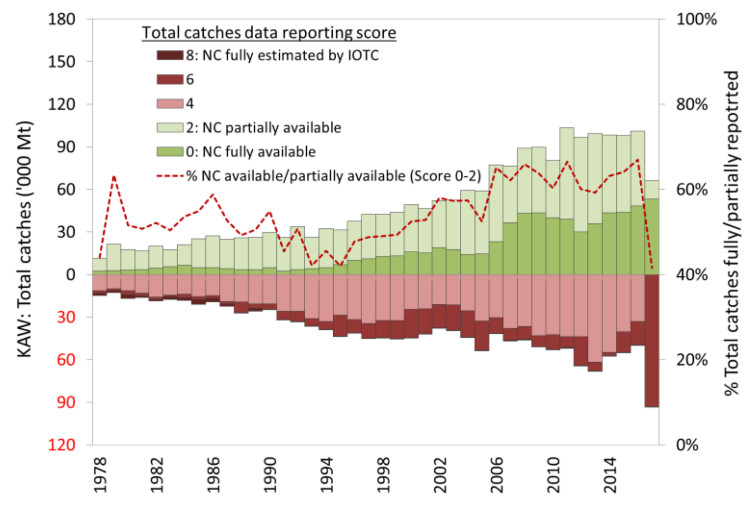


Fig.27. Kawakawa: nominal catch; uncertainty of annual catch estimates (1977–2017).

Catches are assessed against IOTC reporting standards, where a score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2 – 6 do not report catch data fully by gear and/or species (i.e., partially adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; catches with a score of 8 refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat).

**** Note: The high proportion of catches estimated in 2017 are due to partial data submission by Indonesia and non-reporting by India.***

[12] Countries are ordered from left to right, according to the importance of catches of longtail reported for 2013-2017. The red line indicates the (cumulative) proportion of catches of longtail tuna for the countries concerned, over the total combined catches of this species reported from all countries and fisheries for 2013-2017.

Kawakawa tuna – Effort trends

- Availability: Effort trends are unknown for longtail tuna in the Indian Ocean.

Kawakawa tuna – Catch-per-unit-effort (CPUE) trends

- Availability: highly incomplete, with data available for only short periods of time and selected fisheries (**Fig.28**).
- Main CPUE series available: Maldives (baitboats and troll lines) (**Fig.29**), and Sri Lanka (gillnets). However the catch-and-effort data recorded for Sri Lankan gillnets are thought to be unreliable, due to the dramatic changes in CPUE recorded between consecutive years. Also the fishing effort units reported by Maldives changed from trips to fishing days from 2013 onwards.

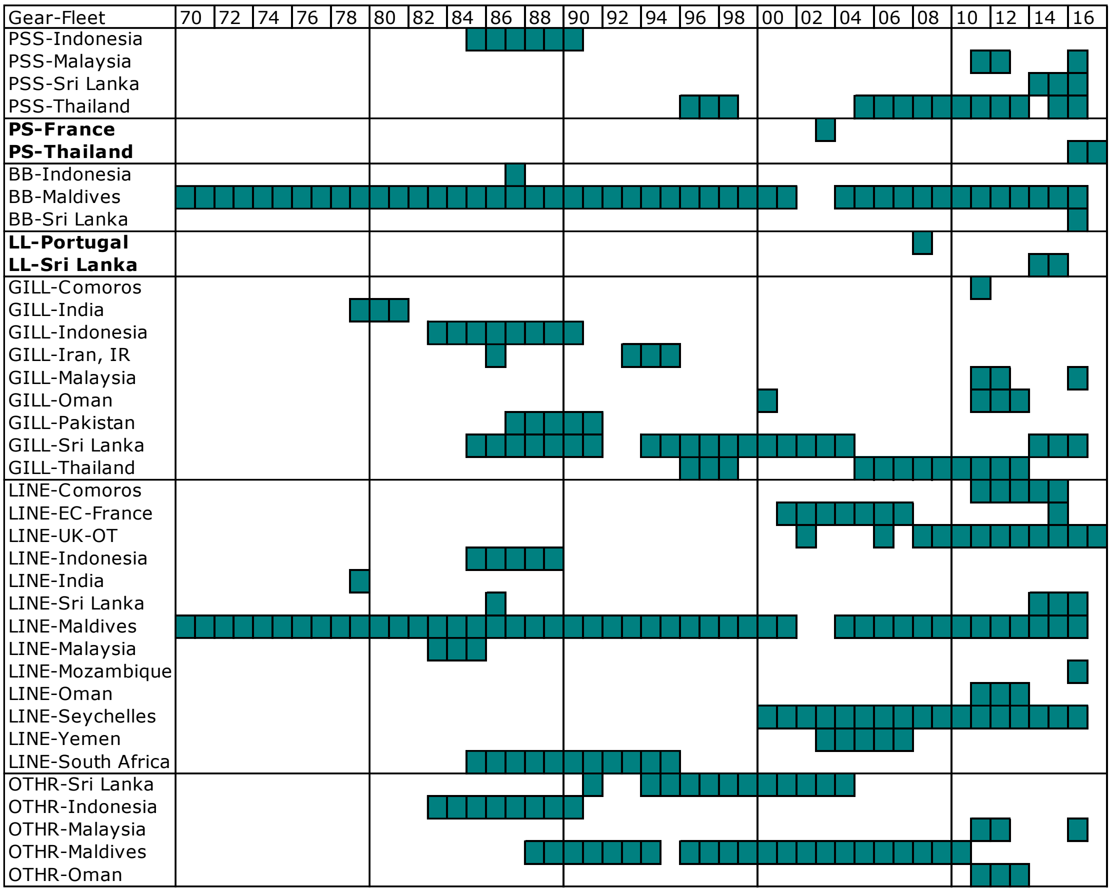


Fig. 28. Kawakawa: Availability of catches and effort series, by fishery and year (1970-2017)[13]. Note that no catches and effort are available at all for 1950–69.

[13] Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, when available catches and effort may not be available throughout the year existing only for short periods

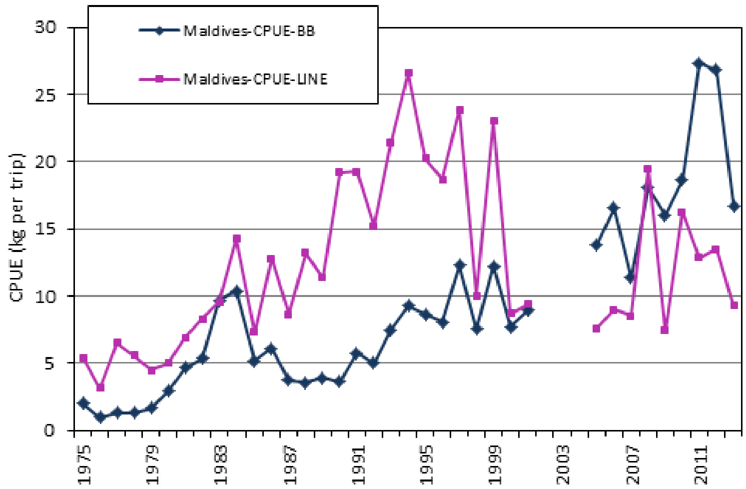


Fig. 29. Kawakawa: Nominal CPUE series for baitboat (BB) and troll line (TROL) fisheries of Maldives (1975–2016) derived from the available catch-and-effort data.

Kawakawa tuna – Fish size or age trends (e.g., by length, weight, sex and/or maturity)

- Sizes: the size of kawakawa taken by the Indian Ocean fisheries typically ranges between 20 and 60 cm depending on the type of gear used, season and location (**Fig.31a**). The coastal purse seine fisheries operating in the Andaman Sea tend to catch kawakawa of a relatively small size (15–30 cm) while gillnet, baitboat and other fisheries operating in the Indian Ocean catch usually larger specimens (25–55 cm).
- Size frequency data: overall highly incomplete, with data only available for selected years and/or fisheries (**Fig.30**).

  Main sources for size samples: Sri Lanka (gillnet), and I.R. Iran (gillnets).
  Trends in average weight can be assessed for Sri Lankan gillnets from the mid-1980s to early-1990s, but the amount of specimens measured has been very low in recent years (**Fig. 31b**). Since 1998 there has also been some sampling of lengths from Iranian gillnets – although average lengths are significantly larger than specimens reported by other fleets which reflect differences in the selectivity of offshore gillnets operating in the Arabian Sea, rather than an actual change in average sizes in the underlying population.
  Length distributions derived from the data available for gillnet fisheries are shown in **Fig.31a**. Data are not available in sufficient numbers for all other fisheries.
- Catch-at-Size (Age) table: Not available, due to lack of size samples and uncertainty over the reliability of retained catch estimates.
- Sex ratio data: have not been provided to the Secretariat by CPCs.

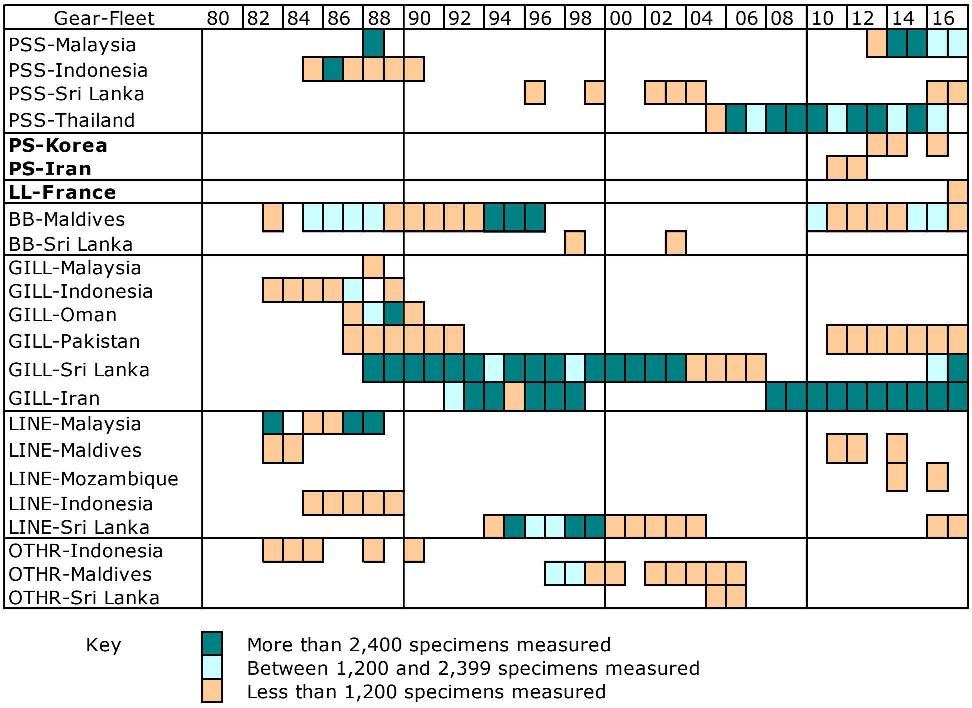


Fig.30. Kawakawa: Availability of length frequency data, by fishery and year (1980-2017)[14]. Note that no length frequency data are available for 1950–82.

Other biological data: Equations available for kawakawa are shown below:

Species	*From type measurement – To type measurement*	*Equation*	*Parameters*	*Sample size*	*Length*
Kawakawa	*Fork length – Round Weight*	*RND=a*L^b*	*a= 0.0000260* *b= 2.9*		*Min: 20* *Max: 65*

Source: Data from North Indian Ocean: IPTP Sampling Programme in Sri Lanka (1989).

[14] Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, when available size data may not be available throughout the year existing only for short periods

APPENDIX IVD
MAIN STATISTICS FOR LONGTAIL TUNA (*THUNNUS TONGGOL*)

Extract from IOTC–2018–WPNT08–07

Fisheries and main catch trends

- Main fisheries: longtail tuna are caught mainly using gillnets and, to a lesser extent, coastal purse seine nets and trolling (**Table 2; Fig. 5**).
- Main fleets (i.e., highest catches in recent years):
  Over 40% of the catches of longtail in the Indian Ocean are accounted for by I.R. Iran (gillnetters), followed by Indonesia (gillnet and trolling), Pakistan (gillnetters) (**Fig.6**).
- Retained catch trends:
  Estimates catches of longtail tuna have increased steadily from the mid-1950s, reaching around 15,000t in the mid-1970's, over 35,000t by the mid-1980's, and more than 96,000 t in 2000. Between 2000 and 2005, catches declined, but have since recovered and reached the highest levels recorded – over 170,000 t in 2011.

  From around 2009 I.R. Iran has reported large increases catches of longtail tuna in coastal waters in the Arabian Sea, as a result of the threat of piracy and displacement of fishing effort (and change of targeting) by gillnet vessels formerly operating in the North-West Indian Ocean. Since 2013 lower catches have been reported – albeit not to pre-piracy levels – in response to the reduced threat of piracy, and resumption of fishing activity on the high seas.
- Discard levels**:** are thought to be very low, although estimates of discards are unknown for most fisheries.

***Changes to the catch series*:** no major changes to the catch series of longtail tuna since WPNT in 2017.

Longtail tuna: estimation of catches – data related issues

Retained catches for longtail tuna were derived from incomplete information – due to deficiencies in port sampling for many of the main fleets – and are therefore uncertain[15] (**Fig.7**); notably for the following fisheries:

- Artisanal fisheries of Indonesia: Indonesia did not report catches of longtail tuna by species or by gear for 1950–2004; instead catches of longtail tuna, kawakawa and other species were reported as aggregated for this period. In the past, the IOTC Secretariat used the catches reported since 2005 to break the aggregates for 1950–2004, by gear and species. However, a recent review by the IOTC Secretariat conducted by an independent consultant in 2012 indicated that catches of longtail tuna had been severely overestimated by Indonesia. While the new catches estimated for the longtail tuna in Indonesia remain uncertain, the new figures are considered more reliable than those existing in the past.

  In addition, the IOTC Secretariat has been conducting a pilot sampling project of artisanal fisheries in North and West Sumatra since 2014 to improve estimates of catch by species for coastal fisheries. One of the key issues is the misclassification of juvenile tunas (*tongkol*) as longtail tuna (*Thunnus tonggol*) by District authorities in Indonesia, which is believed to have led to over-estimates of catches of longtail for a number of years. Based on the results of the pilot sampling, the IOTC Secretariat is working with Indonesia to further improve the estimates of longtail tuna.
- Artisanal fisheries of India and Oman: Although these countries report catches of longtail tuna, until recently the catches have not been reported by gear. The IOTC Secretariat used alternative information to assign the catches reported by Oman by gear. The catches of India were also reviewed by the independent consultant in 2012 and assigned by gear on the basis of official reports and information from various alternative sources.
- Artisanal fisheries of Myanmar and Somalia: None of these countries have ever reported catches of longtail tuna to the IOTC Secretariat. While catch levels are unknown they are unlikely to be substantial. In the case of Myanmar, catches are taken from FAO and SEAFDEC (various years).
- Other artisanal fisheries: The IOTC Secretariat had to estimate catches of longtail tuna for the artisanal fisheries of Yemen (as no data has been reported to the IOTC Secretariat) and until recently Malaysia (with catches of the main neritic tunas aggregated and reported to the IOTC Secretariat as longtail tuna).

[15] The uncertainty in the catch estimates has been assessed by the Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of non-reporting fisheries for which catches had to be estimated.

TABLE 2. Longtail tuna: latest scientific estimates of the catches of longtail tuna by type of fishery for the period 1950–2017 (in metric tonnes). Data as of August 2018.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Purse seine	63	204	1,012	4,863	10,933	17,719	18,885	20,649	16,531	26,062	25,218	17,227	12,770	10,495	11,562	8,966
Gillnet	2,952	6,219	10,026	25,839	41,648	63,485	69,708	87,159	105,094	120,915	115,282	113,001	106,210	98,340	92,390	96,600
Line	554	813	1,519	4,057	5,016	9,502	11,206	12,494	12,977	15,961	25,891	20,647	21,876	19,844	17,282	20,322
Other	0	0	125	1,090	1,992	3,731	5,460	5,300	6,513	8,467	9,073	5,789	4,574	5,862	6,402	9,118
Total	**3,570**	**7,236**	**12,681**	**35,849**	**59,589**	**94,437**	**105,260**	**125,601**	**141,115**	**171,405**	**175,464**	**156,664**	**145,431**	**134,541**	**127,636**	**135,006**

Definition of fishery: Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, danish seine, liftnet, longline, longline fresh, trawling.

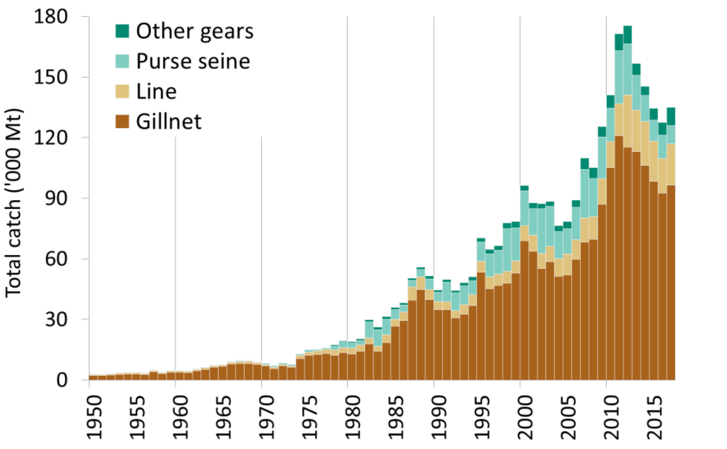


Fig.5. Longtail tuna: Annual catches by gear recorded in the IOTC Database (1950–2017).

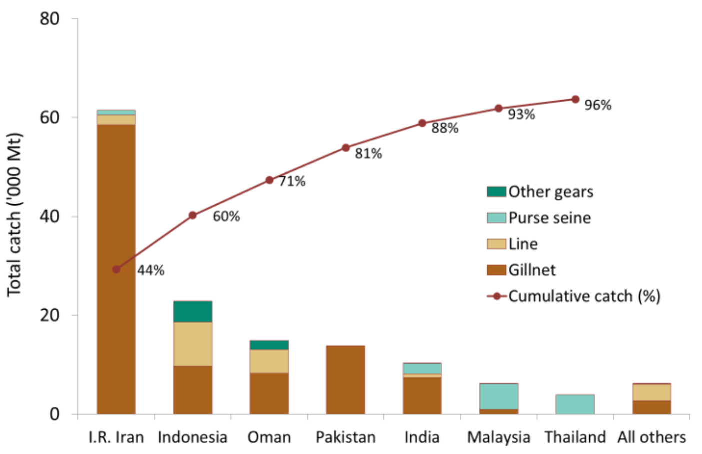


Fig.6. Longtail tuna: Average catches in the Indian Ocean over the period 2013–17, by country[16].

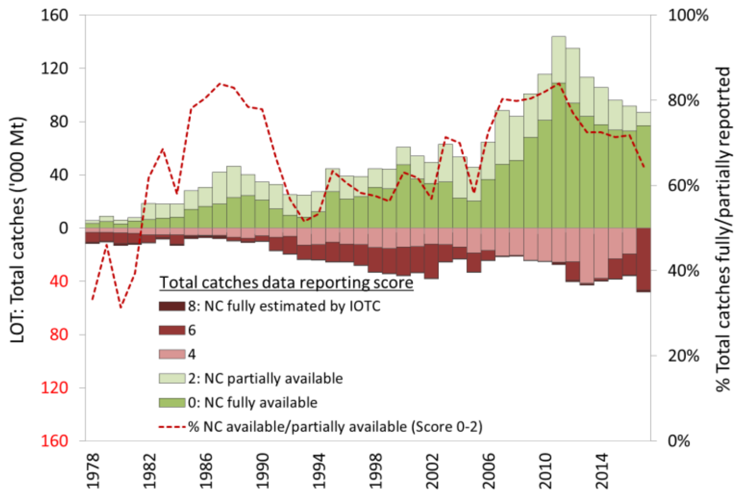


Fig.7. Longtail tuna: nominal catch; uncertainty of annual catch estimates (1978–2017).

Catches are assessed against IOTC reporting standards, where a score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2 – 6 do not report catch data fully by gear and/or species (i.e., partially adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; catches with a score of 8 refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat).

[16] Countries are ordered from left to right, according to the importance of catches of longtail reported for 2013-2017. The red line indicates the (cumulative) proportion of catches of longtail tuna for the countries concerned, over the total combined catches of this species reported from all countries and fisheries for 2013-2017.

Longtail tuna – Effort trends

- Availability: Effort trends are unknown for longtail tuna in the Indian Ocean due to the lack of catch-and-effort data.

Longtail tuna – Catch-per-unit-effort (CPUE) trends

- Availability: highly incomplete, with data available for only short periods of time and selected fisheries (**Fig.8**).
- Main CPUE series available: Thailand coastal purse seine and gillnet vessels (i.e., available over 10 years) (**Fig.9**).

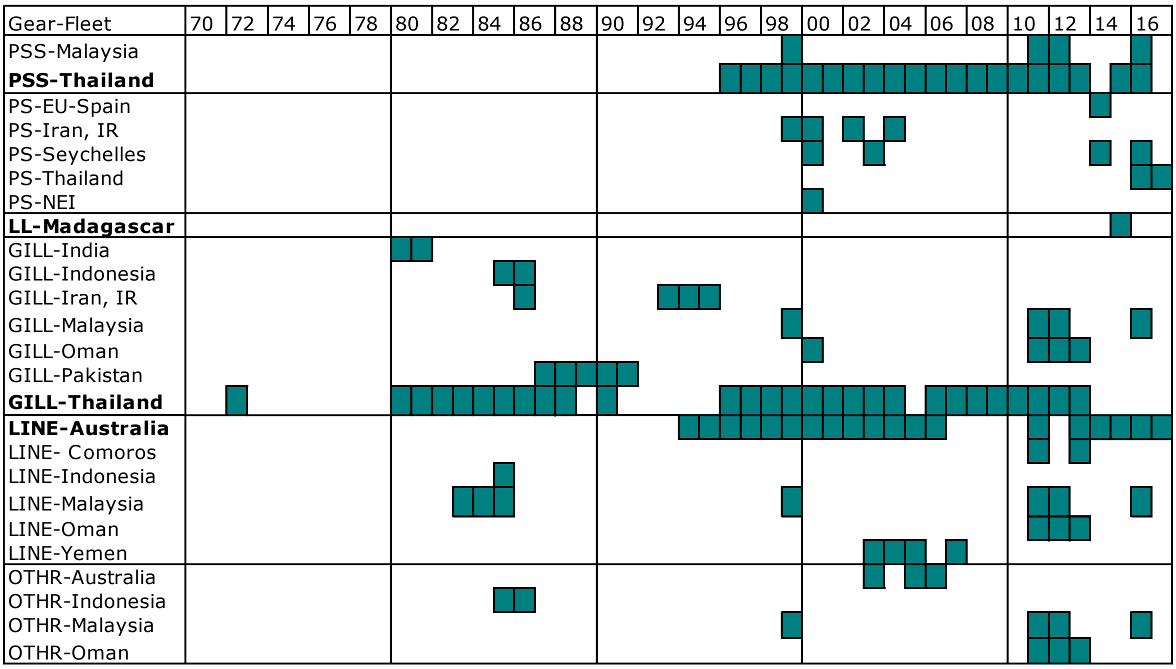


Fig.8. Longtail tuna: Availability of catches and effort series, by fishery and year (1970–2017)[17]. No catch-and-effort is available for 1950–1971.

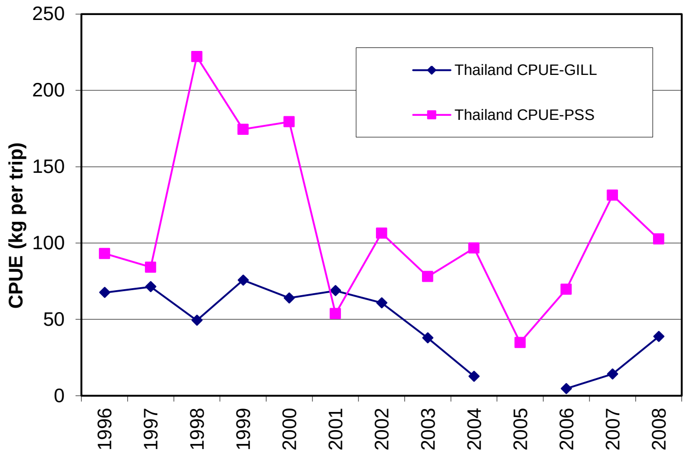


Fig.9. Longtail tuna: Nominal CPUE series for gillnet (GILL) and coastal purse seine (PSS) fisheries of Thailand derived from available catch-and-effort data (1996–2008). Effort reported as fishing days post-2008.

Longtail tuna – Fish size or age trends (e.g., by length, weight, sex and/or maturity)

- Sizes: longtail tunas taken by Indian Ocean fisheries typically range between 20 – 100 cm depending on the type of gear used, season and location (**Fig.10**). Fisheries operating in the Andaman Sea (coastal purse seines and trolling)

[17] Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, catch-and-effort data are sometimes incomplete for a given year, existing only for short periods.

tend to catch smaller sized longtail tuna (e.g., 20–45cm), while gillnet fisheries of I.R. Iran and Pakistan (Arabian Sea) catch larger specimens (e.g., 50–100cm).

- Size frequency data**:** highly incomplete, with data available only for selected fisheries.

  Main sources for size samples: I.R. Iran (gillnet), Oman (gillnet), Pakistan (gillnet), and Thailand (coastal purse seiners).
  Length distributions derived from data available for gillnet fisheries are shown in **Fig.11**. Total numbers of samples, across all years, are also well below the minimum sampling standard of 1 fish per tonne of catch recommended by the IOTC Secretariat to reliably assess changes in average weight.
- Catch-at-Size (Age) table: Not available, due to lack of size samples and uncertainty over the reliability of retained catch estimates.
- Sex ratio data: have not been provided to the Secretariat by CPCs.

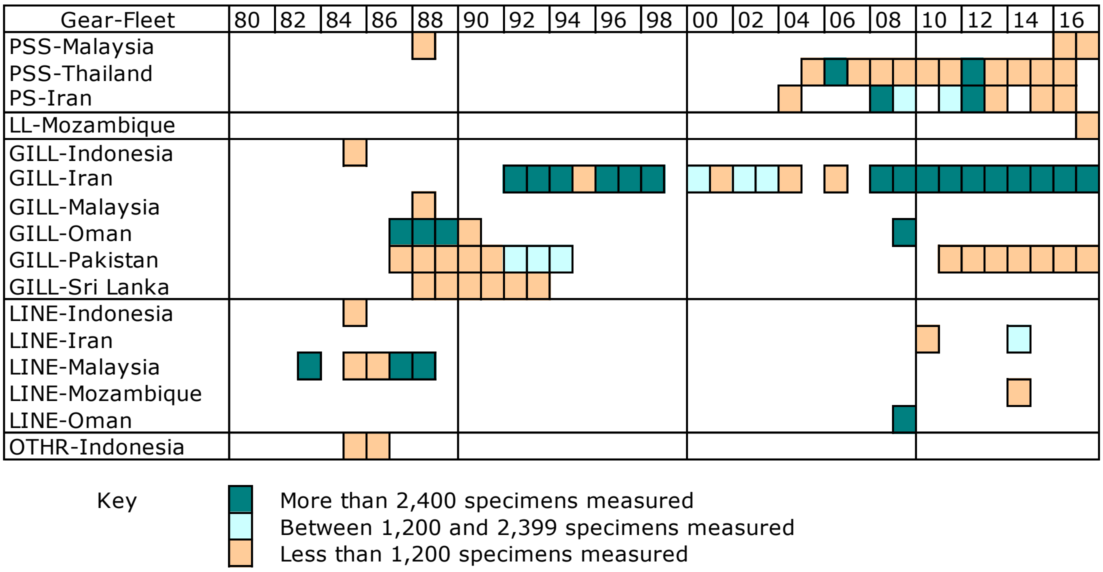


Fig.10. Longtail tuna: Availability of length frequency data, by fishery and year (1980–2016)[18]. Note that no length frequency data are available at all for 1950–1982.

Other biological data: Equations available for longtail tuna are shown below:

Species	*From type measurement – To type measurement*	*Equation*	*Parameters*	*Sample size*	*Length*
Longtail tuna	Fork length – Round Weight	RND=a*L^b	a= 0.00002 b= 2.83		Min:29 Max:128

Source: Data from Indian Ocean: IOTC-2011-WPNT01-18 Population dynamic parameters of Thunnus tonggol in the north of the Persian Gulf and Oman Sea; F.Kaymaram, M. Darvishi, F. Parafkandeh, Sh. Ghasemi & S.A. Talebzadeh.

[18] Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, when available size data may not be available throughout the year existing only for short periods

Fig.11a-b. Left: Longtail tuna (gillnet fisheries): Length frequency distributions (by 1cm length class) derived from data available at the IOTC Secretariat, 1985-2017.

Right: Number of longtail tuna specimens (gillnet fisheries) sampled for lengths, by fleet and year.

APPENDIX IVE
MAIN STATISTICS FOR INDO-PACIFIC KING MACKEREL (*SCOMBEROMORUS GUTTATUS*)

Extract from IOTC–2018–WPNT08–07

Fisheries and main catch trends

- Main fisheries: Indo-Pacific king mackerel[19] are caught mainly by gillnet fisheries in the Indian Ocean, however significant numbers are also caught trolling (**Table7; Fig.39**).
- Main fleets (i.e., in terms of highest catches in recent years):
  Almost two-thirds of catches are accounted for by fisheries in India and Indonesia; with important catches also reported by I.R. Iran (**Fig.40**).
- Retained catch trends:
  Estimated catches have increased steadily since the mid 1960's, reaching around 24,000 t in the late 1970's and over 30,000 t by the mid-1990's, when catches remained stable until around 2006. Since the late-2000s catches have increased sharply, to over 40,000 t, with the highest catches recorded in 2009 at around 53,000 t.
- Discard levels**:** are thought to be very low, although estimates of discards are unknown for most fisheries.

Changes to the catch series**:** There have been no major revisions to the catch series for Indo-Pacific king mackerel since the WPNT meeting in 2017.

Indo-Pacific King mackerel: estimation of catches – data related issues

Retained catches for King mackerel were derived from incomplete information, and are therefore uncertain[20] (**Fig.41**), notably for the following fisheries:

- Species aggregation: King mackerels are often not reported by species but are aggregated with narrow-barred Spanish mackerel or, less frequently, other small tuna species.
- Mislabelling: King mackerels are often mislabelled as narrow-barred Spanish mackerel, their catches reported under the latter species.
- Underreporting: the catches of King mackerel may be not reported for some fisheries catching them as a bycatch.

It is for the above reasons that the catches of King mackerel in the IOTC database are thought to represent only a small fraction of the total catches of this species in the Indian Ocean.

[19] Hereinafter referred to as King mackerel.

[20] The uncertainty in the catch estimates has been assessed by the Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of non-reporting fisheries for which catches had to be estimated.

TABLE 7. *Indo-Pacific king mackerel: Best scientific estimates of the catches of Indo-Pacific king mackerel by type of fishery for the period 1950–2017 (in metric tonnes). Data as of August 2018.*

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Purse seine	-	0	34	584	772	938	1,239	1,605	1,104	1,268	1,103	1,230	1,229	1,115	1,083	1,059
Gillnet	4,366	6,899	13,945	17,096	21,709	23,634	31,192	32,069	26,800	28,498	27,834	29,898	32,563	30,815	29,061	33,041
Line	251	350	771	1,334	1,834	2,504	3,520	4,041	3,497	3,619	3,575	3,656	3,569	3,939	3,952	4,522
Other	13	24	48	3,879	5,100	9,353	11,929	15,733	10,859	11,268	9,964	11,259	10,714	10,234	9,848	11,282
Total	**4,630**	**7,274**	**14,798**	**22,893**	**29,415**	**36,428**	**47,880**	**53,448**	**42,260**	**44,653**	**42,476**	**46,042**	**48,075**	**46,102**	**43,944**	**49,905**

Definition of fishery: Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline, longline fresh, trawling.

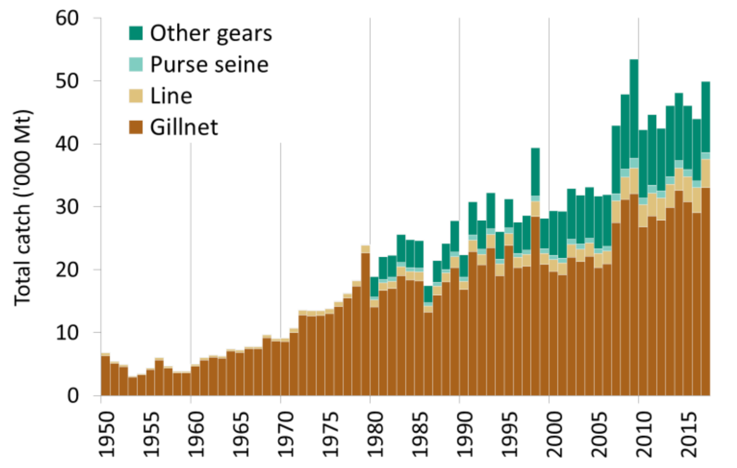


Fig. 39. Indo-Pacific king mackerel: Annual catches by gear recorded in the IOTC Database (1950–2017).

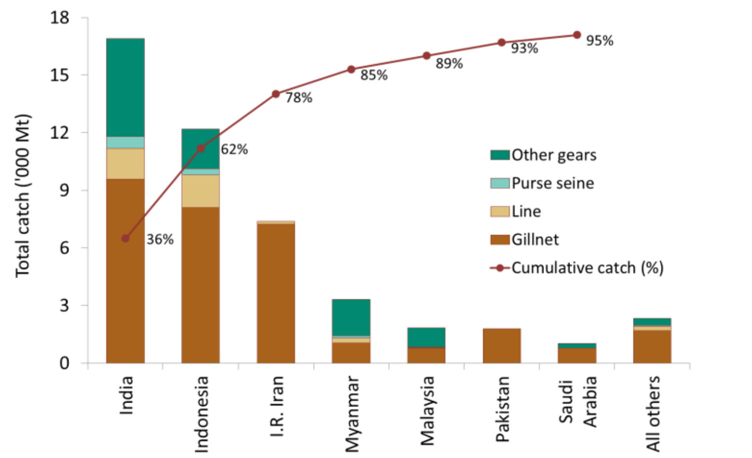


Fig. 40. Indo-Pacific king mackerel: Average catches in the Indian Ocean over the period 2013–17, by country[21].

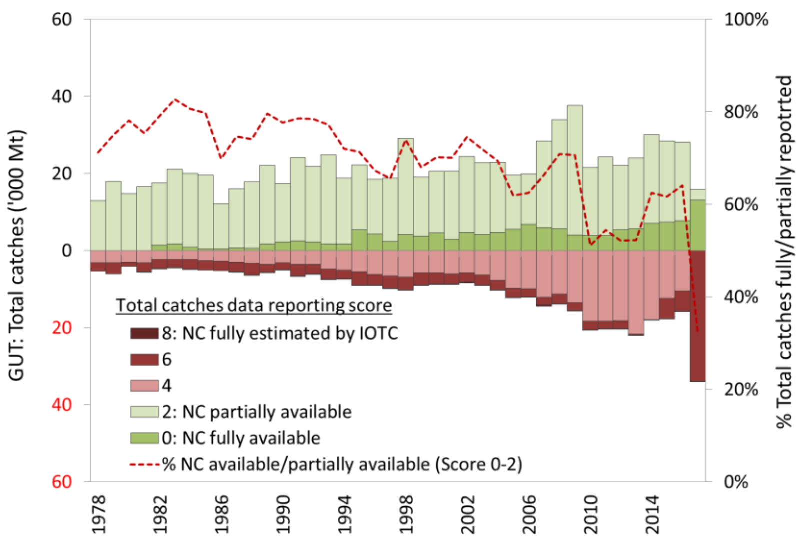


Fig. 41. Indo-Pacific king mackerel: nominal catch; uncertainty of annual catch estimates (1978–2017).

Catches are assessed against IOTC reporting standards, where a score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2 – 6 do not report catch data fully by gear and/or species (i.e., partially adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; catches with a score of 8 refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat).

**** Note: The high proportion of catches estimated in 2017 are due to partial data submission by Indonesia and non-reporting by India.***

[21] Countries are ordered from left to right, according to the importance of catches of longtail tuna 2013-2017. The red line indicates the (cumulative) proportion of catches of longtail tuna for the countries concerned, over the total combined catches of this species reported from all countries and fisheries for 2013-2017.

Indo-Pacific King Mackerel – Effort trends

- Availability: Effort trends are unknown for King Mackerel in the Indian Ocean, due to a lack of catch-and-effort data.

Indo-Pacific King Mackerel – Catch-per-unit-effort (CPUE) trends

- Availability: no data available for most fisheries, and where available, data refer to very short periods (**Fig.42**). This makes it impossible to derive any meaningful CPUE from the existing data.

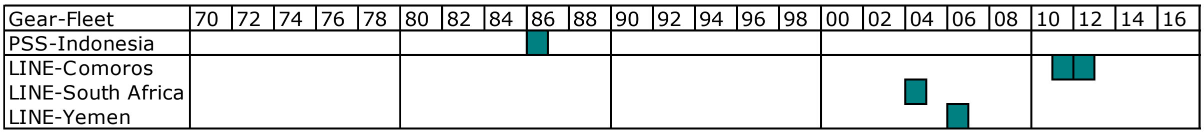


Fig. 42. Indo-Pacific king mackerel: Availability of catches and effort series, by fishery and year (1970–2016)[22]. Note that no catches and effort are available at all for 1950–85.

Indo-Pacific king mackerel – Fish size or age trends (e.g., by length, weight, sex and/or maturity)

- Size frequency data: trends in average weight cannot be assessed for most fisheries due to lack of data.

  Main sources of size samples: Thailand (coastal purse seiner) and Sri Lankan (gillnet) – however the number of samples is very small and the data refer to very short periods (**Fig.43**).
- Catch-at-Size (Age) table: Not available, due to lack of size samples and uncertainty over the reliability of retained catch estimates.
- Sex ratio data: have not been provided to the Secretariat by CPCs.

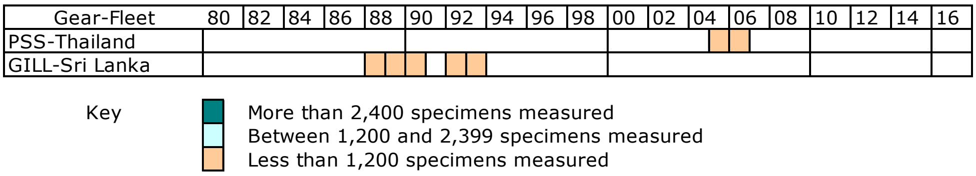


Fig. 43. Indo-Pacific king mackerel: Availability of length frequency data, by fishery and year (1980–2016)[23]. Note that no length frequency data are available for 1950–82.

Other biological data: The equations available for King mackerel are shown below:

Species	*From type measurement – To type measurement*	*Equation*	*Parameters*	*Sample size*	*Length*
Indo-pacific king mackerel	*Fork length – Round Weight*	*RND=a*L^b*	*a= 0.0000100000 b= 2.89400*		*Min:20 Max:80*

Source: Data from North Indian Ocean: IPTP Sampling Programme in Sri Lanka (1989).

[22] Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, when available catches and effort may not be available throughout the year existing only for short periods.

[23] Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, when available size data may not be available throughout the year existing only for short periods.

APPENDIX IVF
MAIN STATISTICS FOR NARROW-BARRED SPANISH MACKEREL (*SCOMBEROMORUS COMMERSON*)

Extract from IOTC–2018–WPNT08–07

Fisheries and main catch trends

- Main fisheries: Narrow-barred Spanish mackerel are caught mainly using gillnet, however significant numbers are also caught using troll lines (**Table 6; Fig.32**).
- Main fleets (i.e., highest catches in recent years):
Fisheries in Indonesia, India, and I.R. Iran account for around two-thirds of catches in recent years (**Fig.33**). Spanish mackerel is also targeted throughout the Indian Ocean by artisanal and sports/recreational fisheries.
- Retained catch trends:
Catches of Spanish mackerel increased from around 50,000 t in the late-1970's to over 100,000 t by the late-1990's. The highest catches of Spanish mackerel have been recorded in recent years since 2011, at over 145,000 t.
- Discard levels**:** are thought to be very low, although estimates of discards are unknown for most fisheries.

***Changes to the catch series*:** No major revisions to the catch series since the WPNT meeting in 2017, with the exception of United Arab Emirates, whose catches were increased by 1000 to 6000 t between 2013-2016 according to data provided by FAO.

Narrow-barred Spanish mackerel: estimation of catches – data related issues

Retained catches for Spanish mackerel were derived from incomplete information, and are therefore uncertain[24] (**Fig.34**), notably for the following fisheries:

- Artisanal fisheries of Indonesia and India: Indonesia and India have only recently reported catches of Spanish mackerel by gear, including catches by gear for the years 2005–08 and 2007–08, respectively. In the past, the IOTC Secretariat used the catches reported in recent years to break the aggregates for previous years, by gear and species. However, in a review conducted by the IOTC Secretariat by an independent consultant in 2012 the catches of narrow-barred Spanish mackerel were reassigned by gear for both India and Indonesia.
- Artisanal fisheries of Madagascar: To date, Madagascar has not reported catches of narrow-barred Spanish mackerel to the IOTC. During 2012 the IOTC Secretariat conducted a review aiming to break the catches recorded in the FAO database as narrow-barred Spanish mackerel by species, on the assumption that all catches of tunas and tuna-like species had been combined under this name (the review used data from various sources including a reconstruction of the total marine fisheries catches of Madagascar (1950–2008), undertaken by the Sea Around Us Project). However the new catches estimated are still considered to be highly uncertain.
- Artisanal fisheries of Somalia: Catch levels are unknown.
- Other artisanal fisheries: UAE do not report catches of narrow-barred Spanish mackerel by gear. Although most of the catches are believed to be taken by gillnets, some narrow-barred Spanish mackerel may be also caught by using small surrounding nets, lines or other artisanal gears. In addition, Thailand report catches of narrow-barred Spanish mackerel and Indo-Pacific king mackerel aggregated.
- All fisheries: In some cases the catches of seerfish species are misreported, with catches of Indo-Pacific king mackerel and, to a lesser extent, other seerfish species reported as narrow-barred Spanish mackerel. Similarly, the catches of wahoo in some longline fisheries are thought to be misreported as narrow-barred Spanish mackerel –

[24] The uncertainty in the catch estimates has been assessed by the Secretariat and is based on the amount of processing required to account for the presence of conflicting catch reports, the level of aggregation of the catches by species and or gear, and the occurrence of non-reporting fisheries for which catches had to be estimated.

although this is thought to have little impact in the case of the narrow-barred Spanish mackerel but may be important for other seerfish species.

TABLE 6. Narrow-barred Spanish mackerel: Best scientific estimates of the catches of narrow-barred Spanish mackerel by type of fishery for the period 1950–2016 (in metric tonnes). Data as of August 2018.

Fishery	By decade (average)						By year (last ten years)									
	1950s	1960s	1970s	1980s	1990s	2000s	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Purse seine	-	1	285	2,355	4,145	5,611	6,133	8,459	8,789	9,113	8,894	9,314	7,997	7,591	7,377	7,177
Gillnet	9,515	17,693	32,168	54,918	62,712	67,069	74,597	76,030	80,532	80,668	87,560	90,035	102,259	96,452	96,563	92,914
Line	1,746	2,476	4,672	11,334	12,071	17,350	19,825	22,369	23,276	28,887	31,836	28,986	29,261	35,246	32,230	31,210
Other	57	101	468	5,603	9,741	21,351	22,741	28,170	24,551	25,802	29,347	26,653	24,089	24,887	25,754	28,069
Total	**11,318**	**20,271**	**37,593**	**74,210**	**88,670**	**111,382**	**123,297**	**135,028**	**137,148**	**144,470**	**157,636**	**154,988**	**163,606**	**164,176**	**161,923**	**159,370**

Definition of fishery: Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline, longline fresh, trawling.

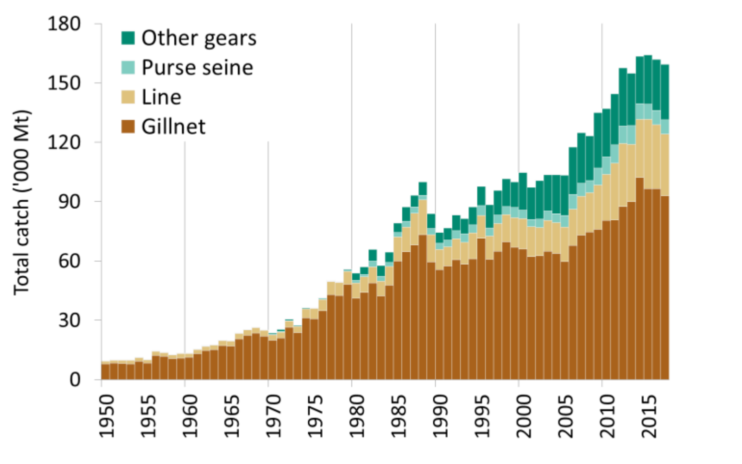


Fig.32. Narrow-barred spanish mackerel: Annual catches by gear recorded in the IOTC Database (1950–2017).

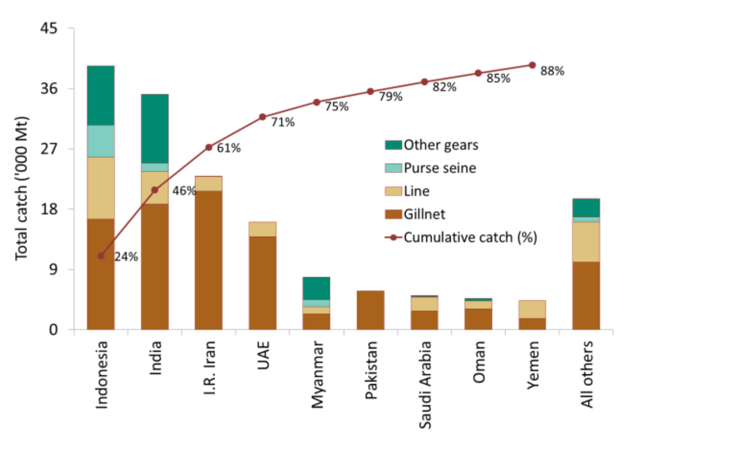


Fig.33. Narrow-barred spanish mackerel: Average catches in the Indian Ocean over the period 2013–17, by country[25].

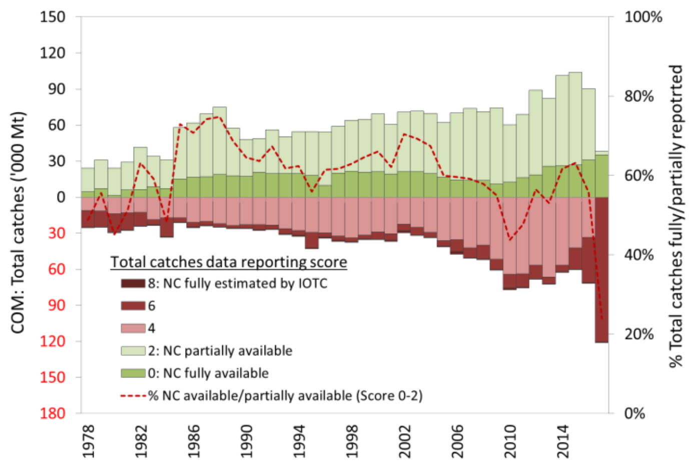


Fig.34. Narrow-barred spanish mackerel: nominal catch; uncertainty of annual catch estimates (1978–2017).

Catches are assessed against IOTC reporting standards, where a score of 0 indicates catches that are fully reported according to IOTC standards; catches assigned a score of between 2 – 6 do not report catch data fully by gear and/or species (i.e., partially adjusted by gear and species by the IOTC Secretariat) or any of the other reasons provided in the document; catches with a score of 8 refer to fleets that do not report catch data to the IOTC (estimated by the IOTC Secretariat).

**** Note: The high proportion of catches estimated in 2017 are due to partial data submission by Indonesia and non-reporting by India.***

[25] Countries are ordered from left to right, according to the importance of catches of longtail reported for 2013-2017. The red line indicates the (cumulative) proportion of catches of longtail tuna for the countries concerned, over the total combined catches of this species reported from all countries and fisheries for 2013-2017.

Narrow-barred Spanish mackerel – Effort trends

- Availability: Effort trends are unknown for Spanish mackerel in the Indian Ocean, due to a lack of catch-and-effort data.

Narrow-barred Spanish mackerel – Catch-per-unit-effort (CPUE) trends:

- Availability: highly incomplete data, available only for selected years and/or fisheries (**Fig.35**).
- Main CPUE series available (i.e., over 10 years or more):
  Sri Lanka (gillnets) – however the catches and effort recorded are thought to be unreliable due to the dramatic changes in CPUE recorded in 2003 and 2004 (**Fig.36**).

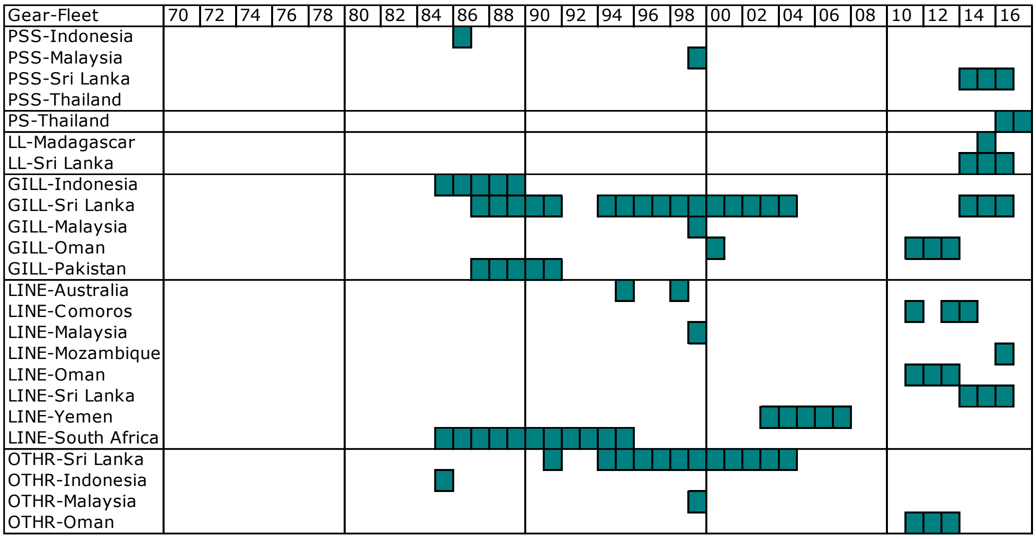


Fig.35. Narrow-barred Spanish mackerel: Availability of catches and effort series, by fishery and year (1970–2017)[26]. No catches and effort are available at for 1950–84, and 2008–10.

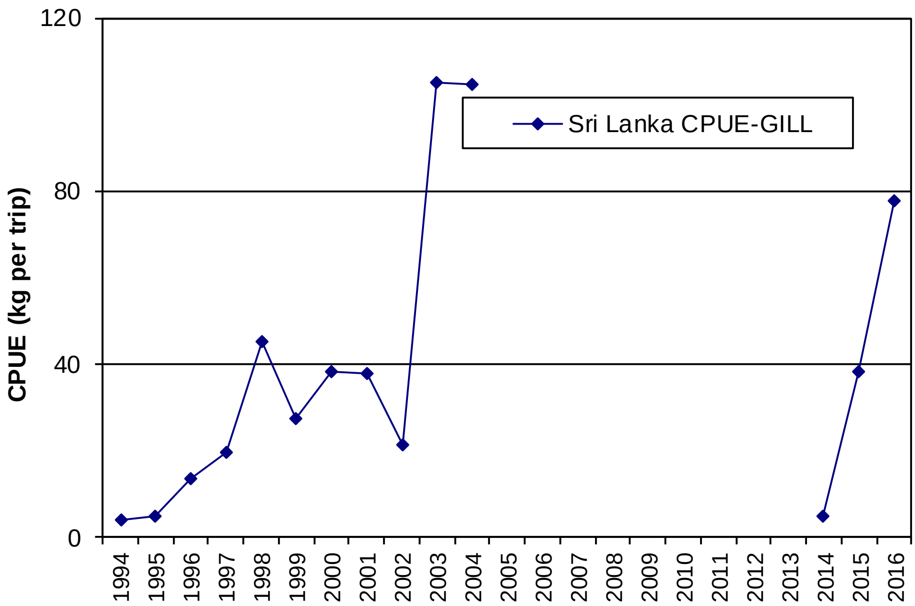


Fig.36. Narrow-barred Spanish mackerel: Nominal CPUE series for the gillnet fishery of Sri Lanka derived from the available catches and effort data (1994–2004 and 2014-2016). No data available since 2004.

[26] Note that the above list is not exhaustive, showing only the fisheries for which catches and effort are available in the IOTC database. Furthermore, when available catches and effort may not be available throughout the year existing only for short periods

Narrow-barred Spanish mackerel – Fish size or age trends (e.g., by length, weight, sex and/or maturity)

- Sizes: the sizes of narrow-barred Spanish mackerel taken by the Indian Ocean fisheries typically ranges between 30 and 140 cm depending on the type of gear used, season and location – with 32–119 cm fish taken in the Eastern Peninsular Malaysia area, 17–139 cm fish taken in the East Malaysia area and 50-90 cm fish taken in the Gulf of Thailand. Similarly, narrow-barred Spanish mackerel caught in the Oman Sea are typically larger than those caught in the Persian Gulf.[27]

- Size frequency data: highly incomplete data, available only for selected years and/or fisheries (**Fig.37**).

  Total numbers of samples, across all years, are also well below the minimum sampling standard of 1 fish per tonne of catch recommended by the IOTC Secretariat to reliably assess changes in average weight.
  Main sources for size samples: Sri Lankan (gillnet) (from late-1980s until early-1990s), and I.R. Iran (gillnet) (from the late-2000s) (**Fig.38b**). Length distributions derived from the data available for gillnet fisheries are shown in (**Fig.38a)**. No data are available in sufficient numbers for other fisheries.
- Catch-at-Size (Age) table: Not available, due to lack of size samples and uncertainty over the reliability of retained catch estimates.

- Sex ratio data: have not been provided to the Secretariat by CPCs.

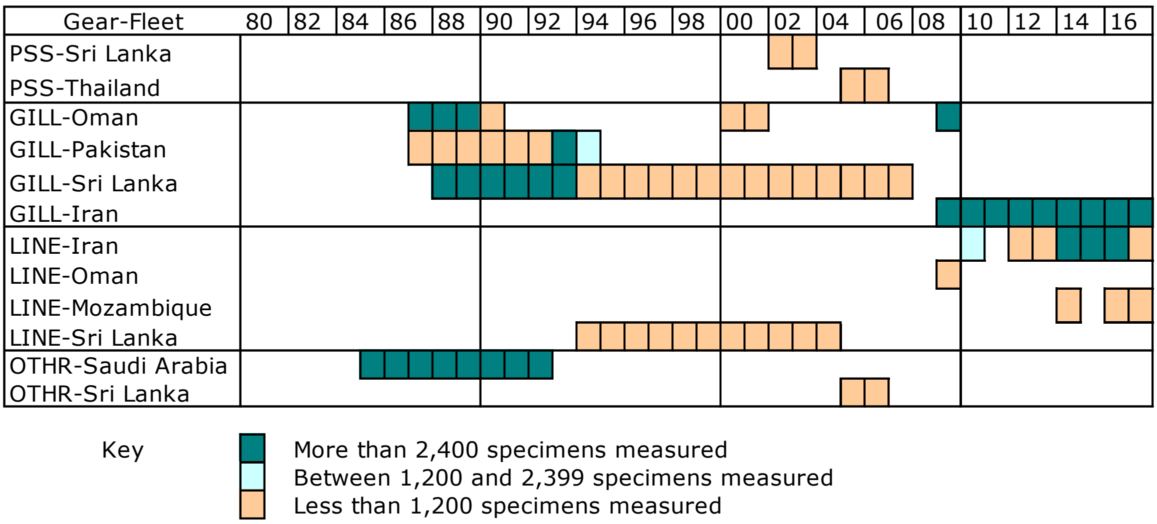


Fig.37. Narrow-barred Spanish mackerel: Availability of length frequency data, by fishery and year (1980–2017)[28]. Note that no length frequency data are available prior to 1984.

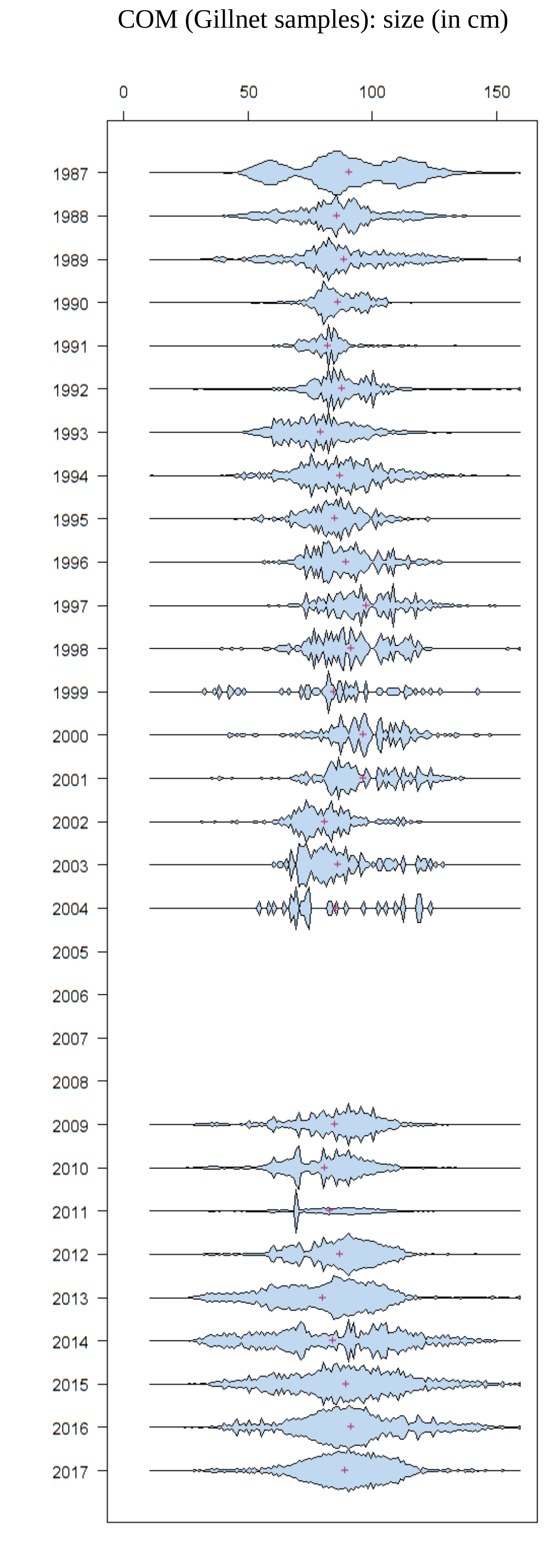
Other biological data: Equations available for Spanish mackerel are shown below:

Species	From type measurement – To type measurement	Equation	Parameters	Sample size	Length
Spanish mackerel	Fork length – Round Weight	RND=a*L^b	a= 0.00001176 b= 2.9002		Min:20 Max:200

Source: Data from North Indian Ocean: IPTP Sampling Programme in Sri Lanka (1989).

[27] The IOTC Secretariat did not find any data in support of this statement.

[28] Note that the above list is not exhaustive, showing only the fisheries for which size data are available in the IOTC database. Furthermore, when available size data may not be available throughout the year existing only for short periods.



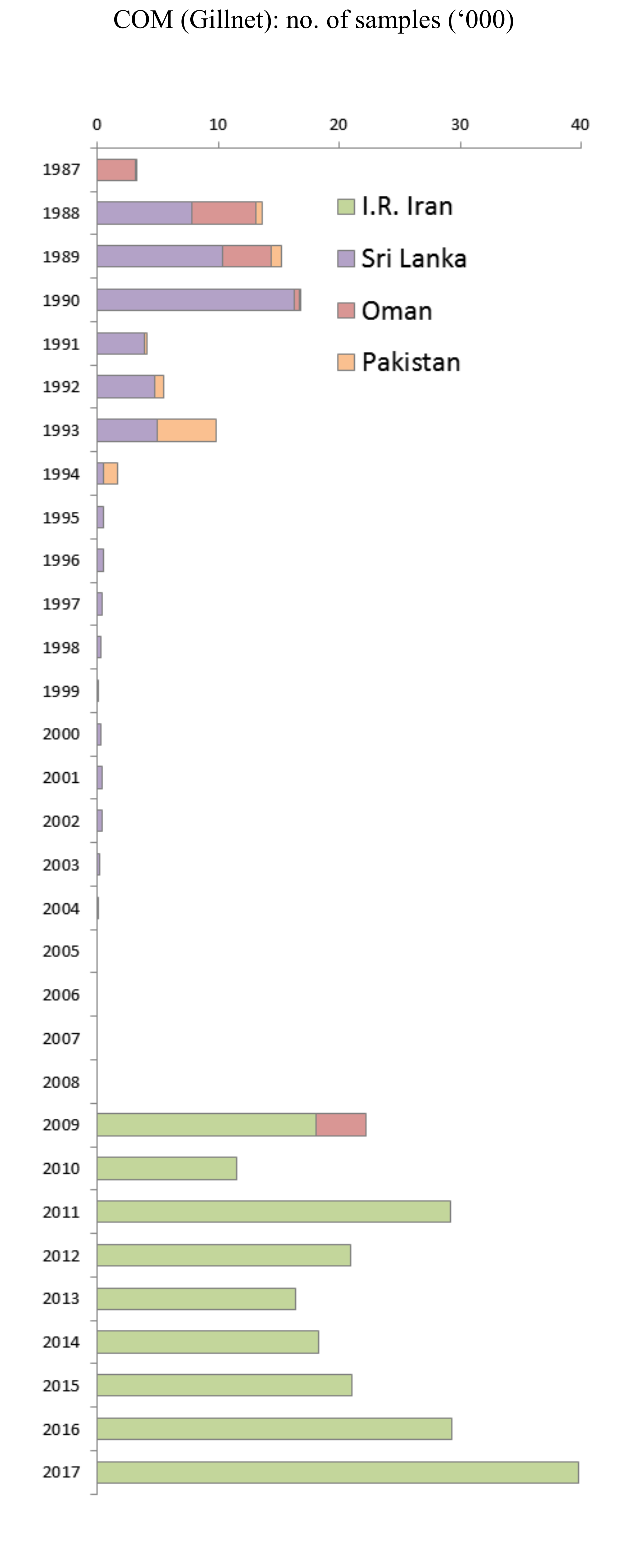


Fig.38a-b. Left: Narrow-barred Spanish Mackerel (gillnet fisheries): Length frequency distributions (by 1cm length class) derived from data available at the IOTC Secretariat, 1987-2017.

Right: Number of narrow-barred Spanish mackerel specimens (gillnet fisheries) sampled for lengths, by fleet and year.

APPENDIX V
MAIN ISSUES IDENTIFIED RELATING TO THE STATISTICS OF NERITIC TUNAS

Extract from IOTC–2018–WPNT08–07

Data type(s)	Fisheries	Issue	Progress
Nominal catch, catch-and-effort, size data	Coastal fisheries of Madagascar, Myanmar, and Yemen	Non-reporting countries Catches of neritic tunas for these fisheries have been entirely estimated by the IOTC Secretariat in recent years – however the quality of estimates is thought to be poor due to a lack of reliable information on the fisheries operating in these countries.	• Madagascar: no regular data collection system exists for recording catches from coastal fisheries. Pilot sampling, funded by COI-SmartFish and assistance from the IOTC Secretariat, was conducted in selected provinces in 2013. Since then Smartfish have agreed to provide Madagascar with additional support for data collection and management. • Myanmar (non-reporting, non-IOTC member): no update. Catches in the IOTC database are based on estimates published by SEAFDEC and FAO FishStat (various years). • Yemen: Catches are estimated based on information provided by FAO FishStat. In 2018 there were revisions to the catch series for Yemen, which affects some species more than others (e.g., narrow-barred Spanish mackerel). Before incorporating revisions to the data for all species, the IOTC Secretariat is currently seeking clarification on the rationale for the scale of the revisions.
Nominal catch, catch-and-effort, size data	Coastal fisheries of India, Indonesia, I.R. Iran, Kenya, Malaysia, Mozambique; Oman, Tanzania, and Thailand	Partially-reported data These fisheries do not fully report catches of neritic tunas by species and/or gear, as per the reporting standards of IOTC Res.15/02. For example: • Nominal catches may have been partially allocated by gear and species by the IOTC Secretariat, where necessary. • Catch and-effort and size data may also be missing, or not fully reported to Res.15/02 standards.	• India: no update. No catch-and-effort or size data has been reported for coastal fisheries. • Indonesia: Catch-and-effort, and size data, reported for coastal fisheries – albeit for a very small number of landing sites (i.e., less than 10) covered by the IOTC-OFCF pilot sampling project. • Kenya: Kenya has recently undertaken a Catch Assessment Survey to improve catch estimates for artisanal fisheries and is currently in the process of finalizing the estimates, with support from the IOTC Secretariat, prior to submission to IOTC. • Mozambique: An IOTC Data Compliance mission was conducted by the IOTC Secretariat in June 2014 to assess current levels of reporting and the status of fisheries data collection. Following the mission, Mozambique reported catch and effort data; however there are still issues on the classification of the different fleets. Size frequency data was also reported by species, for sport and recreational fisheries. • Oman: no update. No size data submitted, although it is understood that data has been collected. • Sri Lanka: while catch-and-effort are submitted as offshore and within the EEZ, it is unclear whether catches within the EEZ refer to the semi-industrial/industrial fisheries. Catch-and-effort for coastal (artisanal) fisheries does not appear to have been reported either. • Tanzania: a data compliance mission was conducted in February 2016, including a list of outstanding issues and recommendations to improve levels of compliance. Catch data (aggregated by species) are based on data from the National Report submitted to SC. Catches also appear to be underreported for some years (i.e., excluding catches from Zanzibar).

	Coastal fisheries of Indonesia, Malaysia, and Thailand	Reliability of catch estimates A number of issues have been identified for the following fisheries, which compromise the quality of the data in the IOTC database.	• Indonesia (nominal catch): catch estimates for neritic tunas are considered highly uncertain due to issues of species misidentification and aggregation of juvenile neritic and tropical tunas species reported as commercial category *tongkol*. The IOTC Secretariat is supporting a pilot sampling project of artisanal fisheries in North and West Sumatra to improve estimates of neritic tunas and juvenile tuna species in particular. • Malaysia (catch-and-effort): no update. Issues regarding the reliability of catch-and-effort reported in recent years have been raised by the IOTC Secretariat and, to date, remain unresolved (e.g., large fluctuations in the nominal CPUE, and inconsistencies between different units of effort recorded in recent years). The upload of catch-and-effort data to the IOTC database remains pending until inconsistencies in the data are satisfactorily resolved. • Thailand (catch-and-effort): no update. Catch-and-effort shows large increases for longtail in recent years, despite a *decrease* in effort. Clarification has been requested from Thailand by the IOTC Secretariat, but no response has been received as yet. The upload of catch-and-effort data to the IOTC database remains pending until inconsistencies in the data are satisfactorily resolved.
Catch and effort, size data	(Offshore) Surface and longline fisheries: I.R. Iran and Pakistan	Non-reporting or partially-reported data A substantial component of these fisheries operates in offshore waters, including waters beyond the EEZs of the flag countries concerned. Although the fleets have reported total catches of neritic tunas, they have not reported catch-and-effort data as per the reporting standards of IOTC Res.15/02.	• I.R. Iran – drifting gillnets: Update: Following an IOTC Data Compliance mission in November 2017, I.R. Iran has submitted catch-and-effort data in a new data reporting format in accordance to the reporting requirements of Resolution 15/02. This should lead to substantial improvements in the data available for the Iranian fisheries in the IOTC database. • Pakistan – drifting gillnets: Update: In 2018 Pakistan began reporting size data for some neritic tuna species (e.g., frigate tuna and kawakawa). However no catch-and-effort has been reported to date, due to deficiencies in the port sampling and absence of logbooks on-board vessels. Update: WWF-Pakistan has been a coordinating a skipper-based observer programme for over two years, which includes information on total enumeration of catches, and fishing location (for sampled vessels) and could be used to estimate catch-and-effort for Pakistan gillnet vessels in the absence of a national logbook program. The IOTC Secretariat is currently liaising with WWF-Pakistan to evaluate the quality of the observer data collected.
Nominal catch, catch-and-effort, size data	All industrial purse seine fisheries	The total catches of frigate tuna, bullet tuna and kawakawa reported for industrial purse seine fleets are considered to be very incomplete, as they do not account for all catches retained onboard and or include amounts of neritic tunas discarded. The same applies to catch-and-effort data.	There is a general lack of information on retained catches, catch-and-effort, and size data for neritic tunas retained by all purse seine fleets – in particular frigate tuna, bullet tuna, and kawakawa. Discard levels of neritic tunas by purse seiners are also only available for the EU purse seine fisheries during 2003-07. Update: No update, although as reporting coverage of the Regional Observer Scheme improves, there is the potential for an improvement in the estimates of catches of neritic species (retained and discarded).
Discards	All fisheries	Although discard levels of neritic species are believed to be low for most fisheries, with the exception of industrial purse seiners, very	The total amount of neritic tunas discarded at sea remains unknown for most fisheries and time periods, other than EU purse seine fisheries during 2003–07.

		little information is available on the level of discards.	Update: No update, although as reporting coverage of the Regional Observer Scheme improves, there is the potential for an improvement in the estimates of catches of neritic species (retained and discarded).
Biological data	All fisheries	There is a general lack of biological data for neritic tuna species in the Indian Ocean, in particular basic data that can be used to establish length-weight-age keys, non-standard measurements-fork length keys and processed weight-live weight keys.	Collection of biological information, including size data, remains very low for most neritic species. Update: The IOTC is coordinating a Stock Structure Project, which commenced in 2016, and aims to supplement gaps in the existing knowledge on biological data and provide an insight on whether neritic tuna and tuna like species should be considered as a single Indian Ocean stock.

APPENDIX VI
WORKING PARTY ON NERITIC TUNAS PROGRAM OF WORK (2019–2023)

The following is the Draft WPNT Program of Work (2019 to 2023) and is based on the specific requests of the Commission and Scientific Committee as well as topics identified during the WPNT08. The Program of Work consists of the following, noting that a timeline for implementation would be developed by the SC once it has agreed to the priority projects across all of its Working Parties:

- **Table 1**: Priority topics for obtaining the information necessary to develop stock status indicators for neritic tunas in the Indian Ocean;
- **Table 2**: Stock assessment schedule.

In selecting the priority projects, the SC is **REQUESTED** to take into consideration the data poor nature of the neritic tuna species and the potentially already fully exploited status of the species. Improved length frequency as well as improved abundance time series would improve stock assessments for these stocks so is a high priority.

Table 1. Priority topics for obtaining the information necessary to develop stock status indicators for neritic tunas in the Indian Ocean

Topic	Sub-topic and project	Priority	Est. budget and/or potential source	Timing				
				2019	2020	2021	2022	2023
1. Data mining and collation	Collate and characterise operational level data for the main neritic tuna fisheries in the Indian Ocean to investigate their suitability to be used for developing standardised CPUE indices. The following data should be collated and made available for collaborative analysis: 1) catch and effort by species and gear by landing site; 2) operational data: stratify this by vessel, month, and year for the development as an indicator of CPUE over time; and 3) operational data: collate other information on fishing techniques (i.e. area fished, gear specifics, depth, environmental condition (near shore, open ocean, etc.) and vessel size (length/horsepower)).	High (1)	CPCs directly					
2. CPUE standardisation	Develop standardised CPUE series for the main fisheries for longtail, kawakawa, Indo-Pacific King mackerel and Spanish mackerel in the Indian Ocean, with the aim of developing CPUE series for stock assessment purposes.	High (2)						
	➢ Sri Lanka (priority species: Frigate tuna, Kawakawa, bullet tuna)		Consultant with CPCs					

	I.R. Iran (priority species: Longtail tuna, Kawakawa, narrow-barred Spanish mackerel, Frigate tuna)		Consultant with CPCs					
	Indonesia (priority species: narrow-barred Spanish mackerel, Kawakawa, longtail tuna, Frigate tuna)		Consultant with CPCs					
	Pakistan (priority species: Longtail tuna, Kawakawa, narrow-barred Spanish mackerel)		Consultant with CPCs					
3. Stock assessment / Stock indicators	Explore alternative assessment approaches and develop improvements where necessary based on the data available to determine stock status for longtail tuna, kawakawa and Spanish mackerel The Weight-of-Evidence approach should be used to determine stock status, by building layers of partial evidence, such as CPUE indices combined with catch data, life-history parameters and yield-per recruit metrics, as well as the use of data poor assessment approaches. Improve the presentation of management advice from different assessment approaches to better represent the uncertainty and improve communication between scientists and managers in the IOTC.	High (3)	IOTC Regular Budget/ EU grant 305					
4. Biological information (parameters for stock assessment)	Quantitative biological studies are necessary for all neritic tunas throughout their range to determine key biological parameters including age-at-maturity, and fecundity-at-age/length relationships, age-length keys, age and growth, longevity which will be fed into future stock assessments.	High (4)	CPCs directly					
5. Stock structure (connectivity)	Genetic research to determine the connectivity of neritic tunas throughout their distributions (LOT, KAW, COM)	High (5)	1.3 m Euro: European Union					
	➢ Determine the degree of shared stocks for all neritic tunas under the IOTC mandate in the Indian Ocean, so as to better equip the SC in providing management advice based on unit stocks delineated by geographic distribution and connectivity. ➢ Genetic research to determine the connectivity of neritic tunas throughout their distributions		TBD					

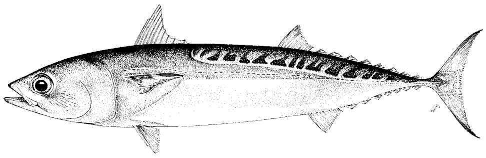
Table 2. Assessment schedule for the IOTC Working Party on Neritic Tunas 2019–2023

Working Party on Neritic Tunas					
Species	**2019****	**2020***	**2021*****	**2022**	**2023***
Bullet tuna	Data preparation	**Assessment**	Data preparation	Data preparation	**Assessment**
Frigate tuna	Data preparation	**Assessment**	Data preparation	Data preparation	**Assessment**
Indo-Pacific king mackerel	Data preparation	**Assessment**	Data preparation	Data preparation	**Assessment**
Kawakawa	Data preparation	**Assessment**	Data preparation	Data preparation	**Assessment**
Longtail tuna	Data preparation	**Assessment**	Data preparation	Data preparation	**Assessment**
Narrow-barred Spanish mackerel	Data preparation	**Assessment**	Data preparation	Data preparation	**Assessment**

* Including data-limited stock assessment methods;
** Including species-specific catches, CPUE, biological information and size distribution;
*** Identification of data gaps and discussion of improvements to the assessments (stock structure);
Note: the assessment schedule may be changed dependent on the annual review of fishery indicators, or SC and Commission requests.

APPENDIX VII
EXECUTIVE SUMMARY: BULLET TUNA

Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
iotc ctoi



Status of the Indian Ocean bullet tuna (BLT: *Auxis rochei*) resource

TABLE 1. Bullet tuna: Status of bullet tuna (*Auxis rochei*) in the Indian Ocean.

Area[1]	**Indicators**		**2018 stock status determination**
Indian Ocean	Catch 2017[2]: Average catch 2013–2017:	11,094 t 9,959 t	
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): B_{MSY} (1,000 t) (80% CI): $F_{current}/F_{MSY}$ (80% CI): $B_{current}/B_{MSY}$ (80% CI): $B_{current}/B_0$ (80% CI):	unknown unknown unknown unknown unknown unknown	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2016: 85%
Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.

Colour key	Stock overfished(SB_{year}/SB_{MSY}< 1)	Stock not overfished (SB_{year}/SB_{MSY}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)		
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)		
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No quantitative stock assessment is currently available for bullet tuna in the Indian Ocean, and due to a lack of fishery data for several gears, only preliminary stock status indicators can be used. Aspects of the fisheries for bullet tuna combined with the lack of data on which to base an assessment of the stock are a cause for concern. Stock status in relation to the Commission's B_{MSY} and F_{MSY} reference points remains unknown (Table 1).

Outlook. Total annual catches for bullet tuna over the past six years have fluctuated but remained around 10,000 t (Fig.1). There is insufficient information to evaluate the effect that these levels of catches, or an increase in catches, may have on the resource. Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered of high priority for the Commission.

Management advice.

For assessed species of neritic tunas in Indian Ocean (longtail tuna, kawakawa and narrow barred Spanish mackerel), the MSY was estimated to have been reached between 2009 and 2011 and both F_{MSY} and B_{MSY} were breached thereafter. Therefore, in the absence of a stock assessment of bullet tuna a limit to the catches should be considered by the Commission, by ensuring that future catches do not exceed the average catches estimated between 2009 and 2011 (8,870 t). The reference period (2009-2011) was chosen based on the most recent assessments of those neritic species in the Indian Ocean for which an assessment is available under the assumption that also for bullet tuna MSY was reached between 2009 and 2011. This catch advice should be maintained until an assessment of bullet tuna is available.

Considering that MSY-based reference points for assessed species can change over time, the stock should be closely monitored. Mechanisms need to be developed by the Commission to improve current statistics by encouraging CPCs to comply with their recording and reporting requirements, so as to better inform scientific advice.

The following should be also noted:

- The Maximum Sustainable Yield estimate for the Indian Ocean stock is unknown.
- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Further work is needed to improve the reliability of the catch series. Reported catches should be verified or estimated, based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered a high priority for the Commission.
- Species identification, data collection and reporting urgently need to be improved.
- There is limited information submitted by CPCs on total catches, catch and effort and size data for neritic tunas, despite their mandatory reporting status. In the case of 2016 catches, 85% of the total catches were either fully or partially estimated by the IOTC Secretariat, which increases the uncertainty of the stock assessments using these data. Therefore the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2013-17)**: bullet tuna is mainly caught using gillnets (≈28%), handlines and trolling (≈30%). This species is also an important catch for coastal purse seiners (Fig. 1).
- **Main fleets (average catches 2013-17)**: Catches are highly concentrated: in recent years over 90% of catches in the Indian Ocean have been accounted for by fisheries in Sri Lanka, Indonesia and India.

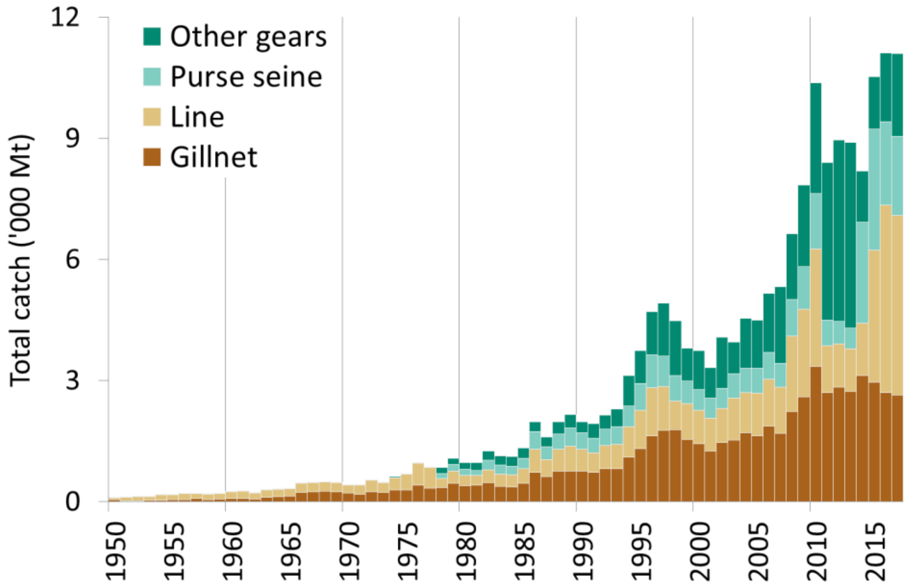


Fig. 1. Bullet tuna: Annual catches of bullet tuna by gear recorded in the IOTC Database (1950–2017)[29].

[29] **Definition of fisheries:** Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline, longline fresh, trawling.

APPENDIX VIII
EXECUTIVE SUMMARY: FRIGATE TUNA

Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
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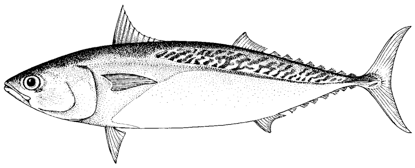

Status of the Indian Ocean frigate tuna (FRI: *Auxis thazard*) resource

TABLE 1. Frigate tuna: Status of frigate tuna (*Auxis thazard*) in the Indian Ocean.

Area[1]	Indicators		2018 stock status determination
Indian Ocean	Catch 2017[2]: Average catch 2013–2017:	74,686 t 86,117 t	
	MSY (1,000 t) (80% CI): F_{MSY} (80% CI): B_{MSY} (1,000 t) (80% CI): $F_{current}/F_{MSY}$ (80% CI): $B_{current}/B_{MSY}$ (80% CI): $B_{current}/B_0$ (80% CI):	unknown unknown unknown unknown unknown unknown	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2018: 80%
Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.

Colour key	Stock overfished($SB_{year}/SB_{MSY} < 1$)	Stock not overfished ($SB_{year}/SB_{MSY} \geq 1$)
Stock subject to overfishing($F_{year}/F_{MSY} > 1$)		
Stock not subject to overfishing ($F_{year}/F_{MSY} \leq 1$)		
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. No quantitative stock assessment is currently available for frigate tuna in the Indian Ocean, and due to a lack of fishery data for several gears, only preliminary stock status indicators can be used. Aspects of the fisheries for frigate tuna combined with the lack of data on which to base an assessment of the stock are a cause for considerable concern. Stock status in relation to the Commission's B_{MSY} and F_{MSY} reference points remains **unknown** (Table 1).

Outlook. Total annual catches for frigate tuna have increased substantially in recent years with peak catches taken in 2010 (~100,000 t) which have been maintained at that level until 2014 after which they declined to <80,000 t (Fig.1). There is insufficient information to evaluate the effect that this level of catch or a further increase in catches may have on the resource. Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered of high priority for the Commission.

Management advice. For assessed species of neritic tunas in Indian Ocean (longtail tuna, kawakawa and narrow barred Spanish mackerel), the MSY was estimated to have been reached between 2009 and 2011 and both F_{MSY} and B_{MSY} were breached thereafter. Therefore, in the absence of a stock assessment of frigate tuna a limit to the catches should be considered by the Commission, by ensuring that future catches do not exceed the average catches estimated between 2009 and 2011 (94,921 t). The reference period (2009-2011) was chosen based on the most recent assessments of those neritic species in the Indian Ocean for which an assessment is available under the assumption that also for bullet tuna MSY was reached between 2009 and 2011. This catch advice should be maintained until an assessment of frigate tuna is available. Considering that MSY-based reference points for assessed species can change over time, the stock should be closely monitored. Mechanisms need to be developed by the Commission to improve current statistics by encouraging CPCs to comply with their recording and reporting requirements, so as to better inform scientific advice.

The following should be also noted:

- The Maximum Sustainable Yield estimate for the Indian Ocean stock is unknown.

- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Further work is needed to improve the reliability of the catch series, such as verification or estimation based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered of high priority for the Commission.
- Species identification, data collection and reporting urgently need to be improved.
- There is limited information submitted by CPCs on total catches, catch and effort and size data for neritic tunas, despite their mandatory reporting status. In the case of 2017 catches, 80% of the total catches were either fully or partially estimated by the IOTC Secretariat, which increases the uncertainty of the stock assessments using these data. Therefore the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2013-17)**: frigate tuna is mainly caught using gillnets (≈35%), coastal longline and trolling, handlines and trolling (≈37%), and to a lesser extent coastal purse seine nets (Table 3; Fig.12). The species is also a bycatch for industrial purse seine vessels and is the target of some ring net fisheries.
- **Main fleets (average catches 2013–17)**: Catches of frigate tuna are highly concentrated: Indonesia accounts for around two-thirds of catches, while over 90% of catches are accounted for by four countries (Indonesia, India, Sri Lanka and I.R. Iran).

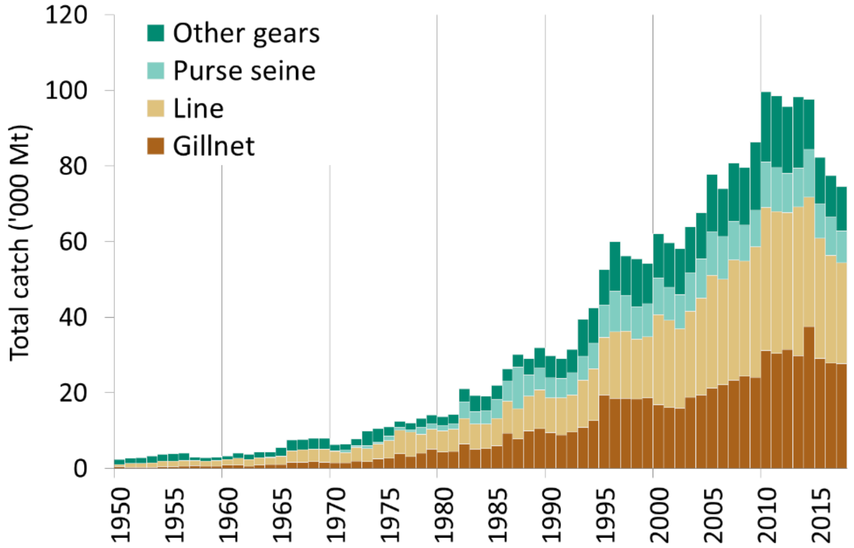

Fig. 1. Frigate tuna: Annual catches of frigate tuna by gear recorded in the IOTC Database (1950–2017)[30].

[30] **Definition of fishery:** Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline, longline fresh, trawling.

APPENDIX IX
EXECUTIVE SUMMARY: KAWAKAWA

Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
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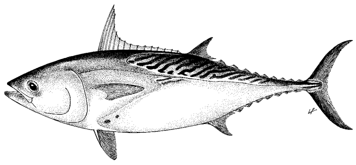

Status of the Indian Ocean kawakawa (KAW: *Euthynnus affinis*) resource

TABLE 1. Kawakawa: Status of kawakawa (*Euthynnus affinis*) in the Indian Ocean.

Area[1]	Indicators		2018 stock status determination
Indian Ocean	Catch 2017[2]: Average catch 2013-2017:	159,752 t 157,300 t	
	MSY (1,000 t) [*] F_{MSY} [*] B_{MSY} (1,000 t) [*] F_{2013}/F_{MSY} [*] B_{2013}/B_{MSY} [*] B_{2013}/B_0 [*]	152 [125 –188] 0.56 [0.42–0.69] 202 [151–315] 0.98 [0.85–1.11] 1.15 [0.97–1.38] 0.58 [0.33–0.86]	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2017: 58%
Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.
*Range of plausible values of biologically realistic OCOM model realizations (see IOTC-2015-WPNT05-R)

Colour key	Stock overfished(SB_{year}/SB_{MSY}< 1)	Stock not overfished (SB_{year}/SB_{MSY}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)		
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)		
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. A stock assessment was not undertaken for kawakawa in 2017 and the status is determined on the basis of the 2015 assessment, which used catch data from 1950 to 2013. Analysis using an Optimised Catch Only Method (OCOM) approach in 2015 indicates that the stock is near optimal levels of F_{MSY}, and stock biomass is near the level that would produce MSY (B_{MSY}). Due to the quality of the data being used, the simple modelling approach employed in 2015, and the large increase in kawakawa catches over the last decade (Fig. 1), measures need to be taken in order to decrease the level of catches which surpassed the estimated MSY levels since 2011. Catches between 2014 and 2017 are lower than those estimated in 2013. Based on the weight-of-evidence available, the kawakawa stock for the Indian Ocean is classified as **not overfished** and **not subject to overfishing** (Table 1, Fig. 2).

Outlook. There is considerable uncertainty about stock structure and the estimate of total catches. Due to the uncertainty associated with catch data (e.g. 58% of catches partially or fully estimated by the IOTC Secretariat in 2017) and the limited number of CPUE series available for fleets representing a small proportion of total catches, only data poor assessment approaches can currently be used. Aspects of the fisheries for this species, combined with the lack of data on which to base a more complex assessment (e.g. integrated models) are a cause for considerable concern. In the interim, until more traditional approaches are developed, data-poor approaches will be used to assess stock status. The continued increase in annual catches for kawakawa is likely to have further increased the pressure on the Indian Ocean stock. Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered a high priority for the Commission. The assessment projections conducted in 2015 concluded that there would be a high risk of exceeding MSY-based reference points if catches were maintained at 2013 levels (96% risk that B_{2016}<B_{MSY}, and 100% risk that F_{2016}>F_{MSY}) (Table 2). However, catches have since declined from 167,348 t (2013) to 159,752 t (2017).

Management Advice. Although the stock status is classified as not overfished and not subject to overfishing, the Kobe strategy II matrix developed in 2015 showed that there is a 96% probability that biomass is below MSY levels and 100%

probability that $F>F_{MSY}$ by 2016 and 2023 if catches are maintained at the 2013 levels. There is a 55% probability that biomass is below MSY levels and 91% probability that $F>F_{MSY}$ by 2023 if catches are maintained at around 2016 levels. The modelled probabilities of the stock achieving levels consistent with the MSY reference points (e.g. $SB > SB_{MSY}$ and $F<F_{MSY}$) in 2023 are 100% for a future constant catch at 80% of 2013 catch levels. If catches are reduced by 20% based on 2013 levels at the time of the assessment (170,181 t)[31], the stock is expected to recover to levels above MSY reference points with a 50% probability by 2023.

The following should be also noted:

- The Maximum Sustainable Yield estimate for the Indian Ocean is estimated to be 152,000 with a range between 125,000 and 188,000 t and so catch levels should be reduced in future to prevent the stock becoming overfished.
- Further work is needed to improve the reliability of the catch series. Reported catches should be verified or estimated, based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Improvement in data collection and reporting is required if the stock is to be assessed using integrated stock assessment models.
- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered of high priority for the Commission.
- Given the limited information submitted by CPCs on total catches, catch and effort and size data for neritic tunas, despite their mandatory reporting status, the IOTC Secretariat was required to estimate 63% of the catches (in 2016), which increases the uncertainty of the stock assessments using these data. Therefore the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2013–17)**: Kawakawa are caught mainly by gillnets (≈52%), handlines and trolling (≈17%), and coastal purse seiners, and may also be an important bycatch of the industrial purse seiners (Fig. 1).
- **Main fleets (average catches 2013–17)**: Catches are highly concentrated: Indonesia, India, and I.R. Iran account for over two thirds of catches in recent years.

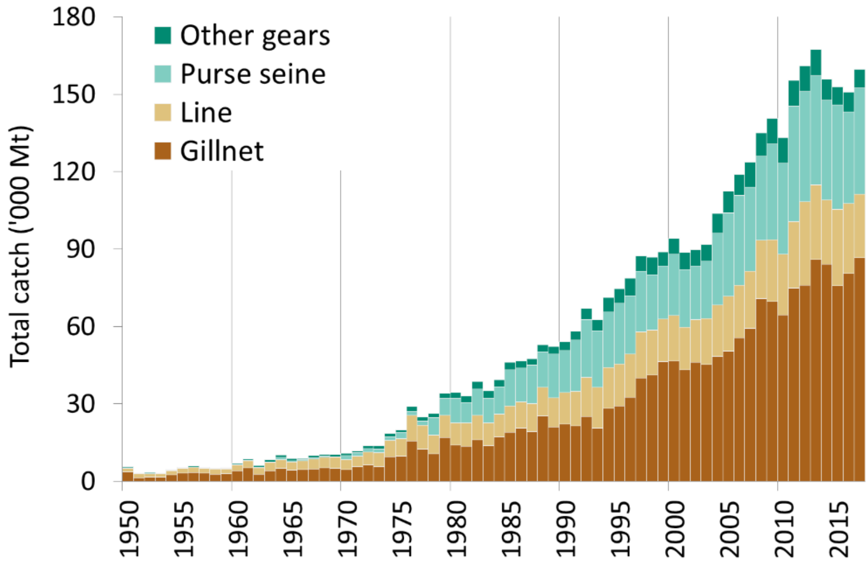

Fig.1. Kawakawa: Annual catches of kawakawa by gear recorded in the IOTC database (1950–2017)[32].

[31] as estimated in 2015

[32] **Definition of fishery:** Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline, longline fresh, trawling.

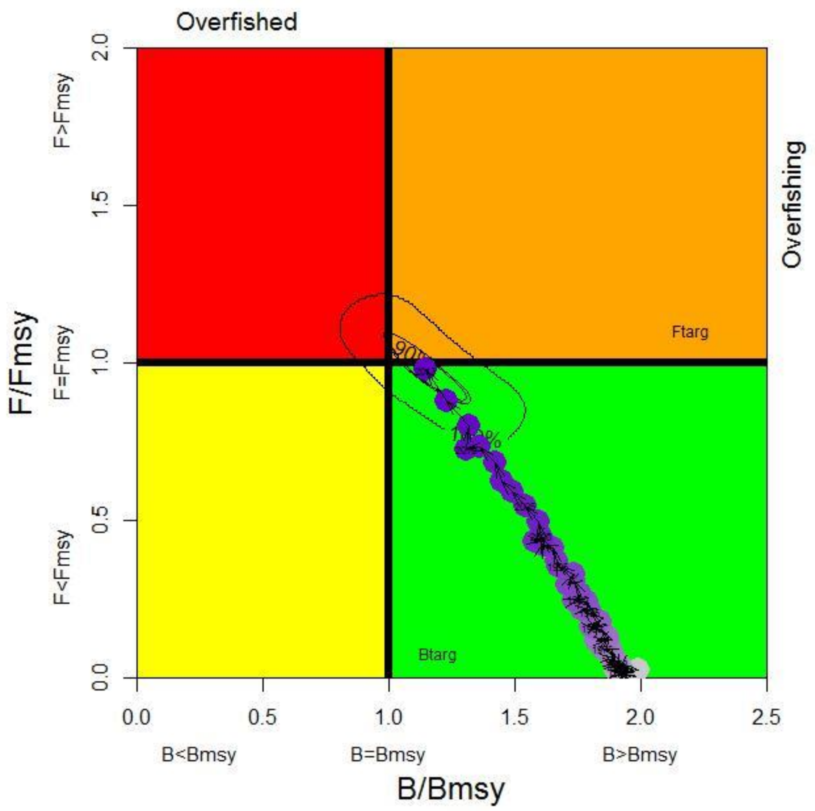

Fig.2. Kawakawa. OCOM aggregated Indian Ocean assessment. Blue circles indicate the trajectory of the point estimates for the B ratio and F ratio for each year between 1950 and 2013 (the black lines represent all plausible model runs shown around 2015 estimate).

Table 2. Kawakawa: OCOM Aggregated Indian Ocean assessment Kobe II Management Strategy Matrix. Probability (percentage) of plausible models violating the MSY-based reference points for five constant catch projections (2013 catch level, -10%, -20%, -30%, +10% and +20%) projected for 3 and 10 years. Note: from the 2015 stock assessment using catch estimates (i.e. 1950-2013) at that time.

Reference point and projection timeframe	**Alternative catch projections (relative to 2013) and weighted probability (%) scenarios that violate MSY-based reference points**					
	70% (119,126 t)	**80%** (136,144 t)	**90%** (153,162 t)	**100%** (170,181 t)	**110%** (187,199 t)	**120%** (204,216 t)
$B_{2016} < B_{MSY}$	0	1	37	96	n.a.	100
$F_{2016} > F_{MSY}$	0	18	87	100	100	100
$B_{2023} < B_{MSY}$	0	0	55	100	100	100
$F_{2023} > F_{MSY}$	0	0	91	100	100	100

APPENDIX X
EXECUTIVE SUMMARY: LONGTAIL TUNA

Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
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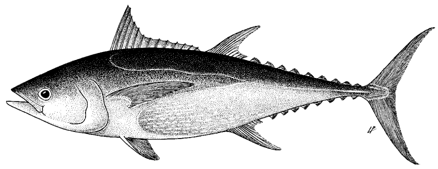


Status of the Indian Ocean longtail tuna (LOT: *Thunnus tonggol*) resource

TABLE 1. Longtail tuna: Status of longtail tuna (*Thunnus tonggol*) in the Indian Ocean.

Area[1]	Indicators		2018 stock status determination
Indian Ocean	Catch 2017[2]:	135,006 t	67%
	Average catch 2013–2017:	139,856 t	
	MSY (1,000 t) (*):	140 (103–184)	
	F_{MSY} (*):	0.43 (0.28–0.69)	
	B_{MSY} (1,000 t) (*):	319 (200–623)	
	F_{2015}/F_{MSY} (*):	1.04 (0.84–1.46)	
	B_{2015}/B_{MSY} (*):	0.94 (0.68–1.16)	
	B_{2015}/B_0 (*):	0.48 (0.34–0.59)	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catches estimated or partially estimated by IOTC Secretariat in 2017: 36%
Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.
*Range of plausible values of biologically realistic OCOM model realizations (IOTC-2017-WPNT07-R)

Colour key	Stock overfished(SB_{year}/SB_{MSY}< 1)	Stock not overfished (SB_{year}/SB_{MSY}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)	67%	0%
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)	6%	27%
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. Analysis using the Optimised Catch-Only Method (OCOM) indicates that the stock is being exploited at a rate that exceeded F_{MSY} in recent years and the stock appears to be below B_{MSY} and above F_{MSY} (67% of plausible models runs) (Fig. 2). Catches were above MSY between 2010 and 2014, however catches have decreased between 2012 and 2016 from ~175,000 to ~128,000 t (Fig. 1) and were below estimated MSY in 2017. The F_{2015}/F_{MSY} ratio is slightly lower than previous estimates, reflecting the decrease in catches reported in the last few years. Nevertheless, the estimate of the B_{2015}/B_{MSY} ratio (0.94) was also slightly lower than in previous years. An assessment using the revised Catch-MSY method was also undertaken in 2017 and results were consistent with OCOM in terms of status. Therefore, based on the weight-of-evidence currently available, the stock is considered to be both **overfished** and **subject to overfishing** (Table 1; Fig. 2).

Outlook. There remains considerable uncertainty about stock structure and the total catches in the Indian Ocean. The increase in annual catches to a peak in 2012 increased the pressure on the longtail tuna Indian Ocean stock, although the catch trend has reversed since then. As noted in 2015, the apparent fidelity of longtail tuna to particular areas/regions is a matter for concern as overfishing in these areas can lead to localised depletion. Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered a high priority for the Commission.

Management advice. There is a substantial risk of exceeding MSY-based reference points by 2018 if catches are maintained at current (2015) levels (63% risk that $B_{2018}<B_{MSY}$, and 55% risk that $F_{2018}>F_{MSY}$) (Table 2). If catches are reduced by 10% this risk is lowered to 33% probability $B_{2018}<B_{MSY}$ and 28% probability $F_{2018}>F_{MSY}$). If catches are capped at current (2015) levels at the time of the assessment (i.e. 136,849 t), the stock is expected to recover to levels above MSY reference points with at least a 50% probability by 2025. Catches have remained below estimated MSY since 2015.

The following should be also noted:

- The Maximum Sustainable Yield estimate of around 140,000 t was exceeded between 2010 and 2014. Limits to catches are warranted to recover the stock to the B_{MSY} level.
- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Further work is needed to improve the reliability of the catch series. Reported catches should be verified or estimated, based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Improvements in data collection and reporting are required if the stock is to be assessed using integrated stock assessment models.
- Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets (I.R.Iran, Indonesia, Pakistan, India and Oman), size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered a high priority for the Commission.
- There is limited information submitted by CPCs on total catches, catch and effort and size data for neritic tunas, despite their mandatory reporting status. In the case of 2017 catches, 36% of the total catches were either fully or partially estimated by the IOTC Secretariat, which increases the uncertainty of the stock assessments using these data. Therefore the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2013–17)**: Longtail tuna are caught mainly using gillnets and, to a lesser extent, coastal purse seine nets and trolling (Fig. 1).
- **Main fleets (average catches 2013–17)**: Over 44% of the catches of longtail in the Indian Ocean are accounted for by I.R. Iran, followed by Indonesia (≈16%), and Oman (≈11%).

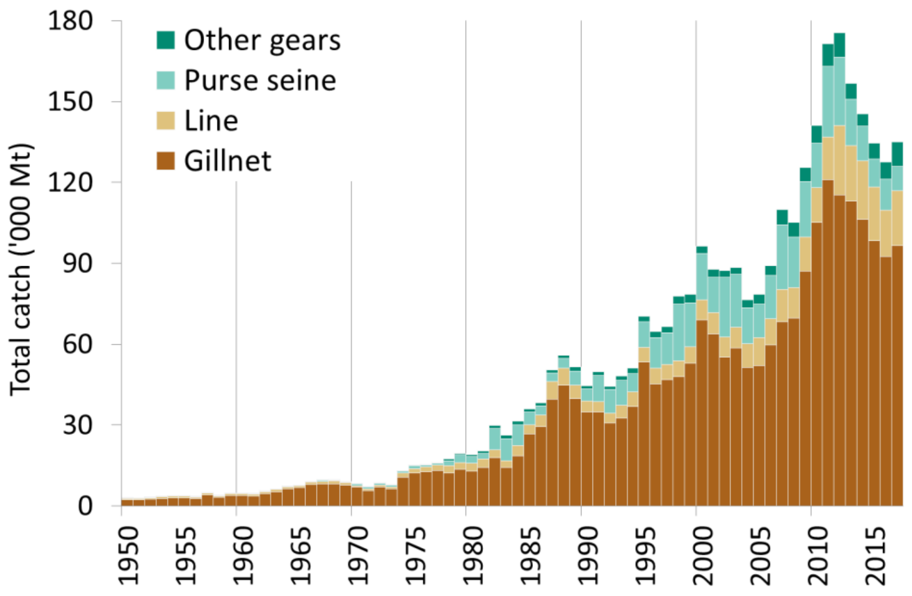


Fig. 1. Longtail tuna: Annual catches by gear recorded in the IOTC Database (1950–2017)[33].

[33] **Definition of fishery:** Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, danish seine, liftnet, longline, longline fresh, trawling.

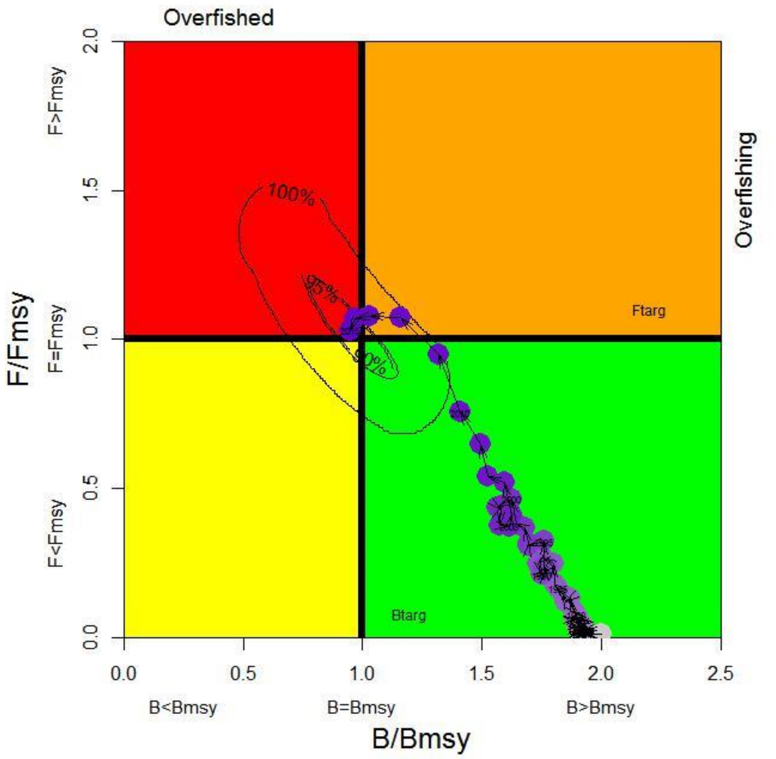


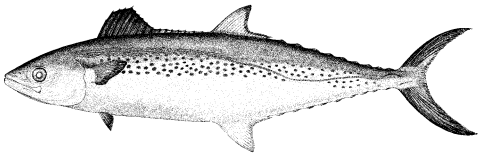
Fig. 2. Longtail tuna. OCOM Indian Ocean assessment Kobe plot. Blue circles indicate the trajectory of the point estimates for the B ratio and F ratio for each year between 1950 and 2015 (the black lines represent all plausible model runs shown around 2015 estimate).

Table 2. Longtail tuna: OCOM aggregated Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based reference points for constant catch projections (2015 +20%,+10%, -10%, - 20%, -30% projected for 3 and 10 years). Note: from the 2017 stock assessment using catch estimates (i.e. 1950-2015) at that time.

Reference point and projection timeframe	**Alternative catch projections (relative to 2015) and weighted probability (%) scenarios that violate MSY-based reference points**					
	70 % (95,794 t)	80% (109,479 t)	90% (123,164 t)	100% (136,849 t)	110% (150,534 t)	120% (164,219 t)
$B_{2018} < B_{MSY}$	4	9	33	63	92	99
$F_{2018} > F_{MSY}$	2	7	28	55	86	98
$B_{2025} < B_{MSY}$	0	0	1	48	100	100
$F_{2025} > F_{MSY}$	0	0	1	41	100	100

APPENDIX XI
EXECUTIVE SUMMARY: INDO-PACIFIC KING MACKEREL

Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
iotc ctoi



Status of the Indian Ocean Indo-Pacific king mackerel (GUT: *Scomberomorus guttatus*) resource

TABLE 1. Indo-Pacific king mackerel: Status of Indo-Pacific king mackerel (*Scomberomorus guttatus*) in the Indian Ocean.

Area[1]	**Indicators**		**2018 stock status determination**
Indian Ocean	Catch 2017[2]: Average catch 2013-2017:	49,905 t 46,814 t	
	MSY (1,000 t): F_{MSY}: B_{MSY} (1,000 t) : $F_{current}/F_{MSY}$: $B_{current}/B_{MSY}$: $B_{current}/B_0$:	Unknown Unknown Unknown Unknown Unknown Unknown	

[1] Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2017: 68%
Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.

Colour key	Stock overfished(SB_{year}/SB_{MSY}< 1)	Stock not overfished (SB_{year}/SB_{MSY}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)		
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)		
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. A preliminary assessment was undertaken for Indo-Pacific king mackerel using catch-only methods techniques (Catch-MSY and OCOM) in 2016. The OCOM model, which was considered the more robust of the two catch-only models in terms of assumptions and treatment of priors, indicated that overfishing was not occurring and the stock was not overfished. The continuing uncertainty in catches (68% estimated) for this species, coupled with the highly variable and uncertain estimates of growth parameters used to estimate model priors, warrant caution in interpreting model results for Indo-Pacific king mackerel. Given that no new assessment was undertaken in 2017, the WPNT considered that stock status in relation to the Commission's B_{MSY} and F_{MSY} target reference points remains **unknown** (Table1).

Outlook. Total annual catches for Indo-Pacific king mackerel have increased over time, reaching a peak of 53,000 t in 2009 and have since fluctuated between 42,000 and 52000 t. There is considerable uncertainty about stock structure and total catches. Aspects of the fisheries for this species, combined with the limited data on which to base a more complex assessment (e.g. integrated models), are a cause for concern. Although data-poor methods are yet to be used to provide stock status advice, further refinements to the catch-only methods and application of additional data-poor approaches may improve confidence in the results. Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered a high priority for the Commission.

Management advice. For assessed species of neritic tunas in Indian Ocean (longtail tuna, kawakawa and narrow barred Spanish mackerel), the MSY was estimated to have been reached between 2009 and 2011 and both F_{MSY} and B_{MSY} were breached thereafter. Therefore, in the absence of a stock assessment of Indo-Pacific king mackerel a limit to the catches should be considered by the Commission, by ensuring that future catches do not exceed the average catches estimated between 2009 and 2011 (46,787 t). The reference period (2009-2011) was chosen based on the most recent assessments of those neritic species in the Indian Ocean for which an assessment is available under the assumption that also for Indo-Pacific king mackerel MSY was reached between 2009 and 2011. This catch advice should be maintained until an assessment of Indo-Pacific king mackerel is available. Considering that MSY-based reference points for assessed species can change over time, the stock should be closely monitored. Mechanisms need to be developed by the Commission to improve current statistics by encouraging CPCs to comply with their recording and reporting requirements, so as to better inform scientific advice.

The following should be also noted:

- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered of high priority for the Commission.
- Further work is needed to improve the reliability of the catch series. Reported catches should be verified or estimated, based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Data collection and reporting urgently need to be improved.
- There is limited information submitted by CPCs on total catches, catch and effort and size data for neritic tunas, despite their mandatory reporting status. In the case of 2017 catches 68% of the total catches were either fully or partially estimated by the IOTC Secretariat, which increases the uncertainty of the stock assessments using these data. Therefore the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2013-17)**: Indo-Pacific King mackerel are caught mainly by gillnets (≈66%), however significant numbers are also caught trolling (Fig. 1).
- **Main fleets (average catches 2013–17)**: Almost two-thirds of catches are accounted for by fisheries in India and Indonesia; with important catches also reported by I.R. Iran.

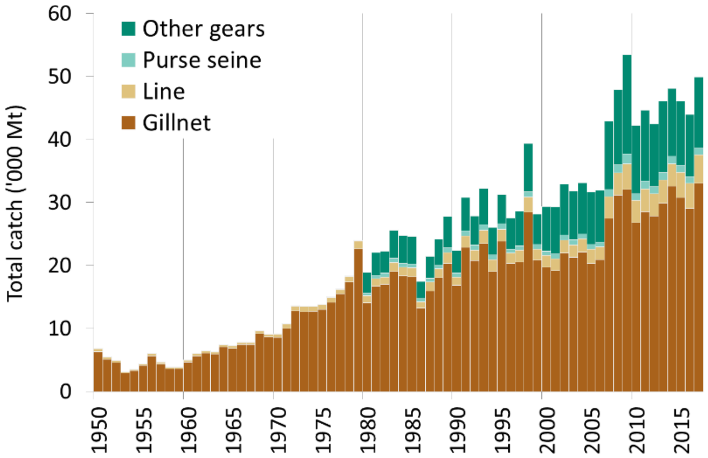
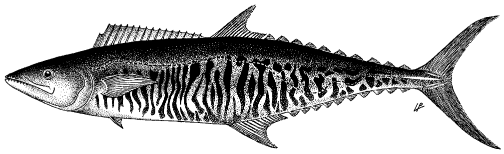


Fig. 1. Indo-Pacific king mackerel: Annual catches of Indo-Pacific king mackerel by gear recorded in the IOTC database (1950–2017)[34]

[34] **Definition of fishery:** Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline, longline fresh, trawling.

APPENDIX XII
EXECUTIVE SUMMARY: NARROW-BARRED SPANISH MACKEREL

Indian Ocean Tuna Commission
Commission des Thons de l'Océan Indien
iotc ctoi



Status of the Indian Ocean narrow-barred Spanish mackerel (COM: *Scomberomorus commerson*) resource

TABLE 1. Narrow-barred Spanish mackerel: Status of narrow-barred Spanish mackerel (*Scomberomorus commerson*) in the Indian Ocean.

Area[1]	Indicators		2018 stock status determination
Indian Ocean	Catch 2017[2]: Average catch 2013-2017:	159,370 t 160,812 t	89%
	MSY (1,000 t) [*]: F_{MSY} [*]: B_{MSY} (1,000 t) [*]: F_{2015}/F_{MSY} [*]: B_{2015} B_{MSY} [*]: B_{2015}/B_0 [*]:	131 [96–180] 0.35 [0.18–0.7] 371 [187–882] 1.28 [1.03–1.69] 0.89 [0.63–1.15] 0.44 [0.31–0.57]	

[1]Boundaries for the Indian Ocean stock assessment are defined as the IOTC area of competence.
[2] Proportion of catch estimated or partially estimated by IOTC Secretariat in 2017: 76%
Nominal catches represent those estimated by the IOTC Secretariat. If these data are not reported by CPCs, the IOTC Secretariat estimates total catch from a range of sources including: partial catch and effort data; data in the FAO FishStat database; catches estimated by the IOTC from data collected through port sampling; data published through web pages or other means; data reported by other parties on the activity of vessels; and data collected through sampling at the landing place or at sea by scientific observers.
*Range of plausible values of biologically realistic OCOM model realizations (IOTC-2017-WPNT07-R)

Colour key	Stock overfished(SB_{year}/SB_{MSY}< 1)	Stock not overfished (SB_{year}/SB_{MSY}≥ 1)
Stock subject to overfishing(F_{year}/F_{MSY}> 1)	89%	11%
Stock not subject to overfishing (F_{year}/F_{MSY}≤ 1)	0%	0%
Not assessed/Uncertain		

INDIAN OCEAN STOCK – MANAGEMENT ADVICE

Stock status. Analysis using the Optimised Catch-Only Method (OCOM) indicates that the stock is being exploited at a rate exceeding F_{MSY} in recent years, and the stock appears to be below B_{MSY}. An analysis undertaken in 2013 in the Northwest Indian Ocean (Gulf of Oman) indicated that overfishing is occurring in this area and that localised depletion may also be occurring[35], though the degree of connectivity of the stock remains unknown. Stock structure remains to be clarified for this stock. Based on the weight-of-evidence available, the stock appears to be **overfished** and **subject to overfishing** (Table 1, Fig. 2). Catches since 2009 and also recent average catches (2013-2017) are well above the current MSY estimate (131,000 t) (Fig. 1).

Outlook. There is considerable uncertainty about stock structure and the estimate of total catches. The continued increase in annual catches in recent years has further increased the pressure on the Indian Ocean narrow-barred Spanish mackerel stock. The apparent fidelity of narrow-barred Spanish mackerel to particular areas/regions is a matter for concern as overfishing in these areas can lead to localised depletion. Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered of high priority for the Commission. There is a very high risk of exceeding MSY-based reference points by 2018 and 2025 if catches are maintained at or even reduced by 10 % from current (2015) levels at the time of the assessment (100% risk that $B_{2018}<B_{MSY}$, and 100% risk that $F_{2018}>F_{MSY}$) (Table 2).

[35] IOTC-2013-WPNT03-27

Management advice. There is a continued high risk of exceeding MSY-based reference points by 2025, even if catches are reduced to 80% of the 2015 levels (73% risk that $B_{2025}<B_{MSY}$, and 99% risk that $F_{2025}>F_{MSY}$). The modelled probabilities of the stock achieving levels consistent with the MSY reference levels (e.g. $B > B_{MSY}$ and $F<F_{MSY}$) in 2025 are 93% and 70%, respectively, for a future constant catch at 70% of current catch level. If catches are reduced by 30% of the 2015 levels at the time of the assessment, which corresponds to catches below MSY, the stock is expected to recover to levels above the MSY reference points with at least a 50% probability by 2025 (Table 2).

The following should also be noted:

- Maximum Sustainable Yield estimate for the Indian Ocean stock was estimated at 131,000 t, while 2017 catches (159,370 t) are exceeding this level.
- Limit reference points: The Commission has not adopted limit reference points for any of the neritic tunas under its mandate.
- Further work is needed to improve the reliability of the catch series. Reported catches should be verified or estimated, based on expert knowledge of the history of the various fisheries or through statistical extrapolation methods.
- Improvement in data collection and reporting is required if the stock is to be assessed using integrated stock assessment models.
- Given the increase in narrow-barred Spanish mackerel catch in the last decade, measures need to be taken to reduce catches in the Indian Ocean (Table 2).
- Research emphasis on collating catch per unit effort (CPUE) time series for the main fleets, size compositions and life trait history parameters (e.g. estimates of growth, natural mortality, maturity, etc.) should be considered of high priority for the Commission.
- There is a lack of information submitted by CPCs on total catches, catch and effort and size data for neritic tunas, despite their mandatory reporting status. In the case of 2017 catches 76% of the total catches were either fully or partially estimated by the IOTC Secretariat, which increases the uncertainty of the stock assessments using these data. Therefore the management advice to the Commission includes the need for CPCs to comply with IOTC data requirements per Resolution 15/01 and 15/02.
- **Main fishing gear (average catches 2013-17)**: Narrow-barred Spanish mackerel are caught mainly using gillnet, however significant numbers are also caught using troll lines (Fig. 1).
- **Main fleets (average catches 2013-17)**: Fisheries in Indonesia, India, and I.R. Iran account for around two-thirds of catches. Spanish mackerel is also targeted throughout the Indian Ocean by artisanal and sports/recreational fisheries.

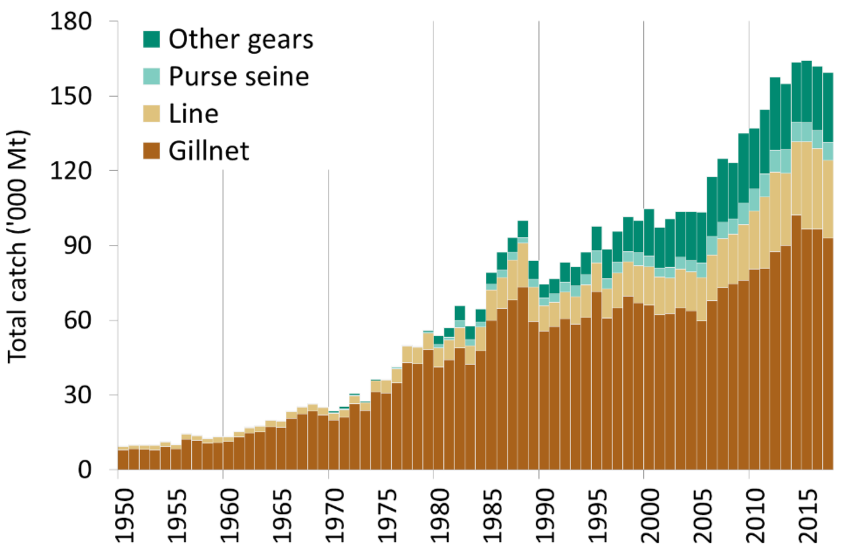


Fig. 1. Narrow-barred Spanish mackerel: Annual catches of narrow-barred Spanish mackerel by gear recorded in the IOTC database (1950–2017)[36].

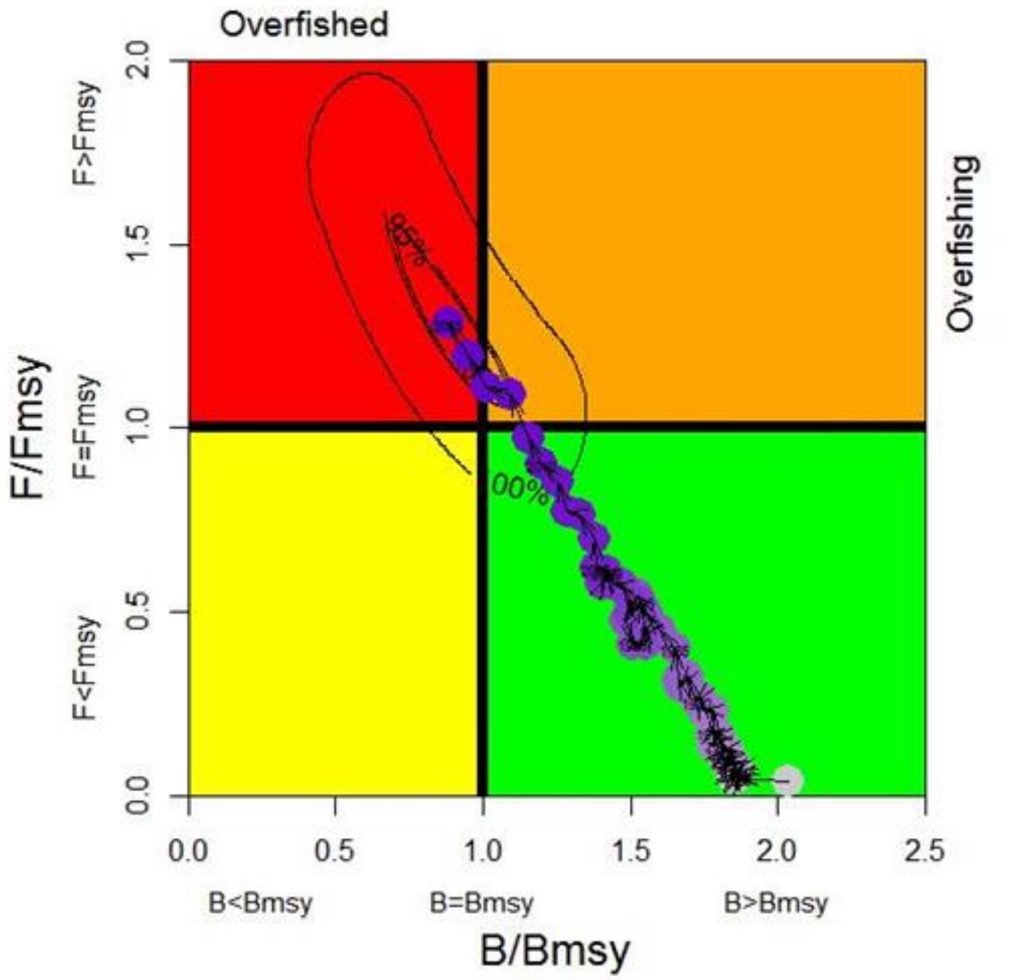


Fig. 2. Narrow-barred Spanish mackerel. OCOM Indian Ocean assessment Kobe plot. Blue circles indicate the trajectory of the point estimates for the B ratio and F ratio for each year between 1950 and 2015 (the black lines represent all plausible model runs shown around 2015 estimate).

Table 2. Narrow-barred Spanish mackerel: OCOM Indian Ocean assessment Kobe II Strategy Matrix. Probability (percentage) of violating the MSY-based reference points for five constant catch projections (2015 catch level, -10%, -20%, -30%, +10% and + 20%) projected for 3 and 10 years. Note: Results are from the 2017 assessment using data up to 2015, available at that time.

Reference point and projection timeframe	**Alternative catch projections (relative to 2015) and weighted probability (%) scenarios that violate MSY-based reference points**					
	70% (107,924 t)	**80%** (123,342 t)	**90%** (138,759 t)	**100%** (154,177 t)	**110%** (169,595 t)	**120%** (185,012 t)
$B_{2018} < B_{MSY}$	71	90	99	100	100	100
$F_{2018} > F_{MSY}$	100	100	100	100	100	100
$B_{2025} < B_{MSY}$	7	73	100	100	100	100
$F_{2025} > F_{MSY}$	30	99	100	100	100	100

[36] **Definition of fishery:** Gillnet: gillnet, including offshore gillnet; Line: coastal longline, hand line, troll line; Purse seine: coastal purse seine, purse seine, ring net; Other gears: baitboat, Danish seine, liftnet, longline, longline fresh, trawling.

APPENDIX XIII
CONSOLIDATED RECOMMENDATIONS OF THE 8TH SESSION OF THE WORKING PARTY ON NERITIC TUNAS

Note: Appendix references refer to the Report of the 8th Session of the Working Party on Neritic Tunas (IOTC–2018–WPNT08–R)

The following are a subset of the complete recommendations from the WPNT08 to the Scientific Committee which are provided at Appendix XIII.

(Para. 22) The WPNT **NOTED** that compliance with data reporting obligations is particularly low for neritic tuna species, despite the importance of scientific data for stock assessment, and **REQUESTED** CPCs do their best to collect data and comply with data reporting requirements adopted by the IOTC. The WPNT further **NOTED** that these issues have been noted for several years with little progress made intersessionally. While there are ongoing initiatives to tackle many of these issues, very little progress has been made and therefore the WPNT strongly **RECOMMENDED** that the Working Party on Data Collection and Statistics take up these issues and address them in that forum.

(Para. 75) The WPNT **NOTED** the low number of participants from CPCs at the current workshop (six excluding the Chair and Vice-Chair) partly due to the technical and specialised focus of the meeting, and **RECOMMENDED** that future capacity building actions and specialised workshops are conducted back-to-back with the regular Working Party meetings so that each CPC can send their most appropriate scientists to the WPs / Workshops.

(Para. 77) The WPNT **RECOMMENDED** that the Commission allocates funding for a consultancy to support the CPCs identified in Appendix VI with CPUE standardisation for the priority species identified.

(Para. 79) The WPNT **RECOMMENDED** that the SC consider and endorse the WPNT Program of Work (2019–2023), as provided in Appendix VI.

(Para. 82) The WPNT **NOTED** that Sri Lanka expressed interest in potentially hosting the 9th Session of the WPNT and **RECOMMENDED** the SC consider as preferred dates of either the last week of June or the first week of July 2019. The WPNT further **NOTED** that Kenya have expressed interest in potentially hosting the 10th Session of the WPNT in 2020 with dates yet to be agreed.

Meeting participation fund (MPF)

(Para. 83) The WPNT participants were unanimous in their thanks for the support for their participation in the meeting due to the MPF and **RECOMMENDED** that the Scientific Committee also consider the WPNT09 as a high priority meeting for MPF.

(Para. 84) The WPNT **RECOMMENDED** that the SC and Commission note the following:

7) The participation of developing coastal state scientists to the WPNT has been consistently high following the adoption and implementation of the IOTC Meeting Participation Fund adopted by the Commission in 2010 (Resolution 10/05 *On the establishment of a Meeting Participation Fund for developing IOTC Members and Non-Contracting Cooperating Parties*), now incorporated into the IOTC Rules of Procedure (2014), as well as though the hosting of the WPNT in developing coastal State Contracting Parties (Members) of the Commission (Table 8).
8) The continued success of the WPNT, at least in the short term, appears heavily reliant on the provision of support via the MPF which was established primarily for the purposes of supporting scientists to attend and contribute to the work of the Scientific Committee and its Working Parties.
9) The MPF should be utilised so as to ensure that all developing Contracting Parties of the Commission are able to attend the WPNT meeting, as neritic tunas are very important resources for many of the coastal countries of the Indian Ocean.

(Para. 85) The WPNT **RECOMMENDED** that the Scientific Committee consider the consolidated set of recommendations arising from WPNT08, provided at Appendix XIII, as well as the management advice provided in the draft resource stock status summary for each of the six neritic tuna (and mackerel) species under the IOTC mandate, and the combined Kobe plot for the species assigned a stock status in 2018 (Fig. 1):

- Bullet tuna (*Auxis rochei*) – Appendix VII
- Frigate tuna (*Auxis thazard*) – Appendix VIII
- Kawakawa (*Euthynnus affinis*) – Appendix IX
- Longtail tuna (*Thunnus tonggol*) – Appendix X
- Indo-Pacific king mackerel (*Scomberomorus guttatus*) – Appendix XI
- Narrow-barred Spanish mackerel (*Scomberomorus commerson*) – Appendix XII